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An Economic Analysis of Shipping Point Inspection of California Table Grapes

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AN ECONOMIC ANALYSIS OF SHIPPING POINT INSPECTION OF CALIFORNIA TABLE GRAPES

by

Stephen H. Sosnick* and Theodore N. Terlecky**

Chapter I

INTRODUCTION

1.1. Objective of the Study

This study was undertaken at the request of personnel in the Budget Division of the Department of Finance of the State of California. They wanted a case study--one that would illustrate the ways in which economic analysis, including benefit-cost analysis, could contribute to evaluating or improving an existing or proposed governmental program.

The State officials let us choose the program, and we chose to study inspection of table grapes by the Bureau of Shipping Point Inspection of the California Department of Agriculture (hereafter, the Bureau is called SPI). We chose this program (or program element) because it appeared to be the one that we might most nearly be able to handle within the limited time and budget that were available. Our objective, then, is to report on SPI's grape inspection activities in a way that illustrates how economic analysis can be helpful to agency heads and to policy makers.

In this introductory chapter we will, in turn, preview our conclusions, describe SPI's activities, itemize the ways in which economic analysis can be helpful, review the principal impediments to measuring the costs and benefits of a program, distinguish three types of amenability to benefit measurement, and explain that we will discuss table grapes inspection as if it fitted each of these three types.

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1.2. Synopsis

The conclusions reached can be summarized as follows: (1) Most of SPI's customers prefer that SPI remain a governmental agency, and the reasons for their preference are sound. (2) SPI charges users for its inspection service, and proponents of user charges have as strong a case with respect to SPI as they could have with respect to any governmental program. In recent years, SPI occasionally has overcharged grape shippers, but usually it has undercharged them, shifting the burden to shippers of other products. The loss could be reduced only by raising SPI's average fee for inspecting grapes. SPI should consider introducing a cooperative-type pricing system involving patronage refunds. SPI also should reconsider its requirement that a shipper's entire pack be inspected if he is to qualify for SPI's equivalent of a quantity discount. (3) With respect to promptness of arrival and accuracy of grading, the effectiveness of SPI's service seems to defy improvement. However, the U.S. Department of Agriculture grading system being used appears to contain serious defects with respect to three factors--grade names, grade widths, and grade specifications. (4) The degree of efficiency that SPI had attained in 1961-1963 appears to have been maintained in 1964-1966. (5) The benefit-cost ratio for 1966 was estimated at 2.8 using a subjective estimate of the dollar value of direct benefits and the bookkeepers' estimate of the dollar value of direct costs.

1.3. The Bureau

SPI has one function--to inspect fresh fruits, vegetables, and nuts and to certify their quality and condition.

Quality is certified in terms of grades. SPI's client chooses the grading system. He usually chooses the official system established by the U.S. Department of Agriculture (USDA). The USDA has established official grade names and grade specifications for all fruits, vegetables, and nuts of importance.

SPI operates pursuant to an agreement between the USDA and the California Department of Agriculture. This agreement dates from 1920. Under it, the State employs inspectors and the USDA licenses them. The USDA also allows free postage, contributes to salaries, supplies certificates, provides handbooks containing information and instructions, furnishes inspection aids such as slides and models, and maintains general supervision of the service. The cooperative nature of the undertaking explains why SPI and its counterparts in other states are known as the Federal-State Inspection Service.

SPI is entirely self-supporting. Unlike its counterparts in certain other states, SPI receives no appropriations. Its funds come from fees charged for its services. SPI is supposed to adjust its fee schedules so that its revenues just cover its explicit costs. The latter consist mostly of inspectors' salaries and travel costs. In addition, 4 percent of the fees collected are transmitted to the USDA as compensation for its services, and about 8 percent goes to the State, which handles purchasing, etc.

Use of SPI's services is optional. Any financially interested party may contact SPI and request inspection. Most calls come from people intending to make shipments to distant markets. With respect to table grapes, the shippers usually are also growers. Some call for inspection routinely; others call at the request of particular buyers.

Two qualifications are needed to the statement that certification by SPI is optional. First, certification is mandatory for part of the California table grape crop under two marketing orders, namely, the federal order for Tokay grapes grown in San Joaquin County and the California order for desert grapes. SPI has been designated the official inspection agency under both of these orders. Second, access to certain foreign markets requires certification by SPI. Most important, Canada requires that all California table grapes that it imports be inspected by SPI before shipment.

SPI has no police power. It does not enforce any regulations, and it does not initiate any disciplinary proceedings. Its inspectors arrive only when invited, and they limit their activities to examining and certifying the quality and condition of the lots that they are requested to inspect. The relevant police power resides in the USDA, which administers the Perishable Agricultural Commodities Act of 1930, an anti-fraud statute. SPI is involved in litigation only in the sense that, under the Perishable Agricultural Commodities Act, federal courts must treat certificates issued by USDA agents (including SPI inspectors), as prima facie evidence of what they state. Certificates issued by SPI, accordingly, would be useful in connection with disputes between shippers and transportation companies. Other benefits are mentioned below.

1.4. Potential Contributions of Economic Analysis

Economic analysis can contribute to program evaluation in various ways. It is convenient to distinguish seven kinds of information that economic analysis may be able to provide.

First, economic analysis may be able to identify the advantages and disadvantages of having a program conducted by a governmental agency instead of by a private organization; it may be able to compare the benefits and costs that exist under governmental operation with the benefits and costs that would exist under private operation and vice versa. For example, economic analysis may be able to indicate how many extra miles motorists would drive to avoid tolls if a bridge or road was put under private ownership and a user charge introduced.[1/]

Second, economic analysis may be able to evaluate the appropriateness of user charges for a governmental program and may be able to indicate whether services that are given might be sold, services that are sold are priced as directed, and prices that are charged could profitably be lowered. For example, economic analysis might indicate that if water prices or nonresident tuition fees were lowered, total program revenues would increase by more than total program costs increase.

Third, economic analysis may be able to identify deficiencies in the effectiveness of program services. It may be able to show that greater benefits can be achieved at the same cost, for example, that existing methods of inspection are less accurate than they could be.

Fourth, economic analysis may be able to identify ways to cut costs. It may be able to show that the same benefits could be achieved at smaller cost. For example, economic analysis might indicate that field offices are located inefficiently or that leasing vehicles would cost less than owning them.

Fifth, economic analysis may be able to predict the change in program costs that would accompany various proposed changes in the quantity or quality of program services. For example, economic analysis might indicate how much money it would cost to operate a vehicle inspection program at various scales and qualities.

[1/] Often, however, some of the grounds for preferring either governmental or private operation are untestable impressions about long-run effects. This may be true with respect to public utilities and government printing offices.

Sixth, economic analysis may be able to compare the benefits of an existing or proposed program with its costs. One can obtain an indication of whether, and by how much, the ratio between the dollar value of program benefits and the dollar value of program costs exceeds one. For example, economic analysis might be able to show that an existing vehicle inspection program produces benefits of at least $1.20 per dollar of costs. In addition, economic analysis may be able to indicate which groups of persons receive the benefits and which bear the burdens.

Seventh, economic analysis may be able to compare program benefits with program costs at various scales and various qualities. It may be able to indicate what change in the dollar value of program costs would accompany various changes in the dollar value of program benefits and vice versa. For example, economic analysis might be able to show that including tires among the items to be examined during vehicle inspection would increase dollar benefits by at least $2.10 per dollar of extra cost. Ideally, economic analysis could identify the quantity and quality of program services from which no change could be made that would add more to dollar benefits than to dollar costs. At this quantity and quality, the ratio between dollar benefits and dollar costs would be optimal.

The foregoing are the principal contributions that economic analysis can make with respect to program evaluation. They are its potential benefits. Economic analysis also has costs. It both takes and uses time. Before arranging for economic analysis, one should decide that there is a good chance that its benefits will outweigh its costs.

1.5. Impediments to Economic Analysis

Different governmental programs are differently amenable to economic analysis. For most programs, it appears that only the first five kinds of information mentioned above can be produced, and that even these cannot be produced without serious reservations. The problem, which applies especially with respect to the sixth and seventh kinds of information, is that it is difficult to measure benefits and costs, especially if one wants to express them in comparable terms.

1.51. Impediments to Measuring Program Costs

The principal impediments to measuring program costs are four in number--capital outlays, common costs, unreliable input prices, and external effects.

The first impediment pertains to capital outlays, that is, to money spent for inputs (such as dams and typewriters) that are used in more than one fiscal year. Occasionally, it is appropriate to disregard such capital outlays in calculating program costs. This is so if three conditions are met: (1) the capital outlays already have been made, (2) the capital assets acquired will have the same salvage value whether or not the program continues to use them, and (3) the question at issue is whether to continue to incur the program's costs. Capital outlays should not be ignored if they have not yet been made, or if the salvage value of the capital assets is reduced by continuing to use them, or if the question is whether users are being charged enough to repay all outlays and to perpetuate the program indefinitely.

There is, however, no fully satisfactory way to incorporate capital outlays in the calculation of program costs. Two approaches have been used to obtain a yearly charge.

The first approach is to calculate an equivalent annual outlay. With this approach, annual capital costs are defined as the annual installment of the annuity whose present value is the same as the present value of the capital outlays that will be made during a particular period of time, perhaps a period equal to the product of the useful lives of the various capital assets used in the program. Calculating annual capital costs in this way requires that someone estimate useful lives and replacement costs and choose an interest rate and a method of allowing for contingencies. While these decisions can be made in a way that seems reasonable, they are inherently arbitrary.

The second approach to incorporating capital outlays is to calculate depreciation. With this approach, capital costs for a particular year consist of an allocated part of past capital outlays. Allocation of capital outlays to individual years requires that someone decide how many years each capital asset will be used and how much of its purchase price should be assigned to each year of its estimated useful life. Both of these decisions can be made in a way that seems reasonable; there are, however, many reasonable ways to estimate useful lives and to calculate depreciation, and the choice of a particular way is arbitrary. Furthermore, both the price level and the timing associated with the capital outlays need recognition. In other words, both a price-level adjustment and a charge for implicit interest are appropriate. (Indeed, with respect to nondepreciating capital assets, such as land, the only charge that is appropriate is the product of an interest rate times the original outlay adjusted to the current price level.) To incorporate interest and price-level adjustments introduces more arbitrary decisions.

In short, the best one can do with respect to capital outlays is to obtain a lower bound, an upper bound, and a "reasonable" point estimate. If the part of total annual costs that is attributable to the use of capital assets is substantial, the corresponding three figures for total annual costs will differ substantially.

The second impediment to measuring program costs is the existence of common costs. Some inputs usually are shared with other programs. For example, different agencies often use the same buildings, vehicles, administrators, auditors, etc. While money spent on such inputs can be allocated to the various programs, choice of a particular formula will be arbitrary. The best that can be done, if common costs are to be included, is to obtain a lower bound, an upper bound, and a reasonable point estimate for the program's share of common costs and then for total program costs. If common costs are large, relative to total costs, the three figures obtained for total costs will differ substantially.

The third impediment to measuring program costs is that the prices paid for program inputs do not necessarily reflect social opportunity costs, that is, the value of the inputs in their best alternative use. Especially when unemployment is substantially above frictional levels, prices paid are not reliable indicators of the value of production that is lost elsewhere because inputs are used in the program. Usually, however, there is nothing else that can be used to indicate how much inputs were worth in other uses.

The fourth impediment is that external diseconomies usually are involved. The sacrifices attributable to a program usually consist of more than the production lost elsewhere when the program obtained its purchased inputs. Some of the sacrifices simply have no counterpart in market transactions. For example, trash disposal programs pay nothing to the people who suffer when burning pollutes the air or when program vehicles add to traffic congestion. Such social losses can be ignored in calculating program costs, but the only justification for doing so is convenience.

In addition, data availability virtually always is a serious practical impediment. Information systems often do not show the amount spent for every input, and never show amounts to be spent in the future.

The most that one can anticipate from an attempt to measure annual program costs, then, is a lower bound, an upper bound, and a best guess as to the governmental expenditures involved.

1.52. Impediments to Measuring Program Benefits

There are two principal impediments to measuring program benefits--output identification and measurement and output valuation.

The first impediment concerns the identification and measurement of program outputs. Program outputs can be defined as goods or services that are produced by program inputs and are recognized as goals of program activities. For some programs, such as lending libraries and trash collection, it is easy to identify and measure items with these properties. For other programs, such as operating parks and patrolling highways, it is difficult or impossible. For the former type, the level of program activity can be measured in terms of the amount of program outputs. For the latter type, the level of program activity can be measured only in terms of the amount of program inputs.

The second impediment concerns the valuation of program outputs. If program outputs are not sold, it is difficult to know how much money would have been paid for them. Even if program outputs are sold, it is difficult to estimate how much extra money the customers would be willing and able to pay rather than do without the outputs. Furthermore, even when outputs are sold, some benefits usually accrue to people who are not customers, such as the people who benefit from the inspection and insurance of others' vehicles; to place a dollar value on program benefits requires deciding how much money such external economies, spillovers, and multiplier effects were worth to the people who received them. Finally, there is the fundamental problem that the dollars that people are willing and able to pay for the outputs of one program are not necessarily equivalent either to the dollars that the beneficiaries of other programs are willing and able to pay or to the dollars that are spent on program inputs. It would, for example, make no sense to value the benefits of providing schooling to slum children by the amount of money that they or their families would be willing and able to pay for them.

Because outputs are hard to quantify and value, a useful measure of the dollar value even of direct program benefits often is not obtainable. In such cases, policy makers who want to judge whether certain expenditures are worthwhile must rely, not partly, but entirely on their own judgment.

1.6. A Typology of Programs

It is evident that the measurement of costs and benefits is possible to different degrees for different programs. In most cases, it is the benefit side of the problem that presents the more severe, or at least novel, difficulties. For present purposes, it is convenient to distinguish three types of programs according to their amenability to benefit measurement.

Type I programs are activities whose direct benefits have counterparts in market transactions. There are three subtypes. Type IA programs are activities whose principal outputs are sold or at least salable. For such programs, an estimate of the dollar value of direct program benefits can be obtained by the methods that economists have developed to estimate the value of privately produced outputs. Among the State and local programs in California that sell their principal outputs, are State parks and colleges and municipal water and garbage services. Type IB programs are activities that increase the market value of other items that are sold. For such programs, an estimate of the dollar value of direct program benefits can be obtained by estimating the increase in market value that is attributable to the program. For example, the dollar value of vocational rehabilitation can be estimated in terms of the increased earnings that are attributable to retraining. Type IC programs are activities that reduce the costs associated with certain other activities. For such programs, an estimate of the dollar value of direct program benefits can be obtained by estimating the reduction in costs attributable to the program. For example, the lives, time, and gasoline saved by constructing a freeway can be estimated and a dollar value assigned to them.

Type II programs are programs whose level of outputs can be measured in physical terms but whose benefits have no transactional counterparts. Examples might be highway beautification, vehicle registration, courts, prisons, and welfare. With respect to highway beautification, for instance, one could measure outputs in terms of shrubs or miles planted, but there seems to be no way to relate the outputs to market transactions.

Type III programs are programs for which no useful estimate can be obtained either of the value or level of outputs. The level of activity of such programs is measurable only in terms of program inputs--for instance, in terms of man hours or payroll. Examples might be the activities of the Highway Patrol, the Department of Finance, and the Alcoholic Beverage Commission.

SPI's inspection of table grapes is a Type IA program. That, indeed, is why we chose to study it. We wanted to study a Type I program because it can be analyzed as such and also as if it were a Type II or III program; and we wanted in particular to study a Type IA program because the existing literature has concentrated on programs of Types IB and IC.[1] Because our purpose is to illustrate what economic analysis can contribute for various types of programs, we will proceed as if SPI were not only Type I, but also Type II or III. In other words, we will, for each issue, indicate (1) what we actually can say, (2) what we could say if we could measure the amount of SPI's grape inspection services but not their dollar value, and (3) what we could say if we could measure neither the dollar value nor the amount of SPI's grape inspection services.

We will keep these distinctions in mind as we discuss the seven topics mentioned above, namely, (1) public versus private, (2) user charges, (3) effectiveness, (4) cost, (5) cost of expansion, (6) the benefit-cost ratio, and (7) the benefits and costs of expansion.

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[1] For some perceptive essays, together with numerous references to the available literature, see Samuel B. Chase, Jr., ed., *Problems in Public Expenditure Analysis*, Washington, D.C., The Brookings Institution, 1968.

Chapter 2

GOVERNMENTAL VERSUS NONGOVERNMENTAL OPERATION

In this chapter, we will try to identify the advantages and disadvantages of having table grapes inspected by a governmental agency instead of by a private organization. Most of what is said could also be said if SPI conducted a program of Type II or III instead of Type I.

2.1. Private Alternatives

There are three relevant private alternatives--a proprietary inspection service, self-inspection, and a cooperative inspection service.

To have SPI's work done by a profit-seeking private organization would not be unprecedented. In the financial realm, bonds and stocks are graded by proprietary concerns.

Self-inspection, too, is not a novel idea. The largest shipper of California citrus fruits, Sunkist Growers, has chosen to inspect its own shipments rather than have SPI do the job. Sunkist's inspectors are supposed to reject fruits that do not meet standards for the organization's brands.

That self-inspection suffices for Sunkist does not, to be sure, make it appropriate for grape shippers. Sunkist is a marketing cooperative which handles the production of many growers and arranges the shipments of a number of packing houses. It has enough tonnage throughout the year to justify maintaining its own inspection staff. Furthermore, Sunkist has established trademarks which can substitute for governmental grade names in identifying quality to buyers. While many shippers of table grapes also have their own inspectors and their own trademarks, most have neither the tonnage nor the established brands that would permit them to operate as Sunkist does. Some, nevertheless, might find SPI dispensable.

A cooperative inspection service also is not a new idea. The primary function of the Dried Fruit Association of California (DFA), a cooperative, is to inspect and certify farm products. DFA was founded in 1908. One of its first activities was to inspect shipments destined for distant markets. DFA also sought to establish a uniform contract with buyers, one provision of which would have made its inspection final. Particularly during periods of price decline, but also when they found themselves overstocked, buyers had been rejecting shipments on arrival because of alleged deficiencies. Since 1927, DFA has been an official inspection agency for dried figs. Since 1933, DFA has inspected walnuts for the Walnut Control Board. Since 1959, it has been used by the Prune Administrative Committee. In addition to these activities (undertaken pursuant to marketing orders), DFA inspects many dried fruits on a voluntary, contractual basis.

We asked DFA's management if they would be willing to undertake the inspection of table grapes. They expressed as much interest in table grapes as in automobiles; neither, they pointed out, is a dried fruit. Nevertheless, having table grapes certified by a nonprofit private organization certainly appears feasible. Indeed, from a purely financial viewpoint, the change would be minimal. SPI, like a cooperative, is supposed to charge its patrons just enough to cover its explicit (accounting) costs.

We decided to ask grape shippers what they thought of the several alternatives.

2.2. Shippers' Reaction

A questionnaire was sent to every shipper of California table grapes that could be located. One of the questions was, "Would you prefer that the Federal-State Inspection Service remain a public organization, or would you like to see it become a private one? Please explain."

The overwhelming majority of the shippers who responded to this question (46 out of 48) said that they preferred that SPI remain governmental.

A number of reasons were given for preferring that SPI remain governmental (none was given for the opposite view). (1) SPI has been fair and objective. (2) By remaining a governmental agency, SPI is more likely to remain free of favoritism, graft, and pressure from its customers. (3) Governmental certification will provide more uniform grading throughout the country. (4) Governmental certification is more likely to discourage unwarranted rejection of shipments by buyers. (5) The armed forces and some of the countries to which table grapes are exported require that the grapes be inspected in the United States by a governmental agency.

Most table grape shippers evidently prefer that inspection remain a governmental activity, and the reasons they give seem to us to be sound. Accordingly, if a case is to be made for converting SPI into a private organization, whether nonprofit or profit seeking, the case apparently will have to be built on ideological, not pragmatic, grounds.

2.3. The Sample of Shippers

Names of all known growers and shippers of table grapes in California were obtained from the Federal-State Market News Service. All of these people were potential users of SPI's services. There were 301 names on the list. In addition, we obtained a list of the shippers who were subject to the two marketing orders for California table grapes. There were 45 names on this list; all of them also appeared on the other list. To these 45 people, who presumably already were SPI customers, one questionnaire was sent. A somewhat different questionnaire was sent to the remaining 256 people, who may or may not have been SPI customers. In both cases, we asked for an anonymous response to encourage candor.

A total of 50 responses was obtained. Of the 45 shippers subject to the marketing order, 14 responded. Of the 256 others, 36 responded. All respondents were SPI customers. Ten of the 301 questionnaires were returned unopened because the addressee left no forwarding address. (Shipping table grapes is a high-risk venture, and many of the people who did not respond may no longer be in business.)

Chapter 3

APPROPRIATENESS OF USER CHARGES

Since 1944, SPI's fees have been under State control. They are set by the Chief of the Bureau, subject to approval of the Director of the State Department of Agriculture.

In this chapter, we will try to evaluate the appropriateness of SPI's fees. Because SPI currently sells its services, we can comment on its actual fee schedule. First, however, we will discuss the merit of charging the users at all, a topic which is pertinent whenever program outputs are measurable.

3.1. Should Users Be Charged?

People often feel that the beneficiaries of a program should pay user charges--usually at rates just high enough to cover the program's explicit costs. The most important reasons for this view seem to be as follows: (1) For the persons who benefit from a program to cover its explicit costs is more equitable than for taxpayers in general to cover them. (2) The higher tax rates that are needed in the absence of user charges have adverse economic effects. (3) If use is voluntary, putting a price on the service will discourage beneficiaries from overusing it. (4) If beneficiaries must pay, political support for programs will more nearly reflect their social value.

On the other hand, charging the beneficiaries of a program also may seem to be inappropriate. The principal reasons appear to be these: (1) If the program is intended to subsidize the beneficiaries, as with general relief and public defenders, charging the beneficiaries would be self-defeating. (2) If use is voluntary and some potential users are relatively poor, letting ability to pay affect the level of use would be inequitable, while avoiding this effect may be difficult or costly, as with parks and emergency hospitals. (3) If use is voluntary and if users are likely either to undervalue their benefits or to disregard the benefits that accrue to third parties, then letting willingness to pay determine the level of use would produce underuse, as with libraries and fire protection. (4) If use is voluntary and the incremental cost of serving an additional person is nil, as with signs and ceremonies, user charges would discourage use needlessly. (5) If the service is mandatory, as with schooling, or if the service is rendered irregularly and before the beneficiaries are identifiable, as with sanitary inspections, imposing a charge would be unfair. (6) If the beneficiaries are identifiable only as "the general public," as with mosquito control and prisons, user charges are not feasible. (7) If the costs of imposing user charges are disproportionate, as with tolls on streets and trails, user charges would be more trouble than they are worth. (8) If the service is rendered to other governemental agencies, and if introducing internal prices is unwise, as with agencies controlling expenditures, then user charges would be senseless.

Of the reasons for avoiding user charges, three might be applied to SPI. The second of the reasons might be applied if some of SPI's patrons were poor. On the other hand, a business input is involved, not a personal service, and some of SPI's patrons clearly are not poor. The third of the reasons might be applied to SPI if benefits to third parties were substantial. However, the benefits of certification accrue mostly to the shippers whose products are inspected, or to people to whom the shippers can pass on SPI's charges. The fifth of the reasons might be applied to SPI if the marketing orders that require certification by SPI were imposed. The marketing orders, however, are sponsored and ratified by the growers involved.

We conclude that the advocates of user charges have as strong a case with respect to SPI as they could have with respect to any governmental program. The issue, however, is not a live one. We have not heard anyone suggest that SPI should terminate its user charges or should charge less than enough to cover its explicit costs.

3.2. Are Existing Fees Appropriate?

We will discuss three aspects of the question: whether SPI's revenues in fact equal its costs, whether the difference between SPI's revenues and SPI's explicit costs would increase (sic) if its fees for table grape inspection were lowered, and whether SPI should introduce quantity discounts.

3.21. Undercharges and Overcharges

SPI is supposed to charge its customers just enough to cover its explicit costs. With respect to grapes, it appears that SPI has not done so in recent years.

Table 3.1 shows SPI's revenues and explicit costs for all years for which data were available. The figures pertain to table grapes and juice grapes combined, since SPI's records group the two together.

It is evident that, for the period 1961 through 1966 as a whole, SPI's revenues for grape inspection did not cover its explicit costs. Revenues were 6 percent short of costs. In this sense, the directive was not fulfilled.

On an annual basis, revenues have differed even more from costs. In one year (1963), SPI's revenues were as much as 12 percent less than its explicit costs. In this sense, too, the directive was not fulfilled.

Failing to match revenues with costs on an annual basis would be significant even if the two were balanced over a number of years. There is appreciable turnover among grape shippers. With year-to-year disparities between SPI's revenues and costs, shippers who are in business when SPI makes a profit in effect subsidize shippers who are in business when SPI incurs a loss.

With its present procedures, SPI cannot avoid annual overcharges and undercharges. SPI can choose fees that seem likely to produce revenues just covering costs, but its actual revenues and costs will depend on what tonnage actually is produced and on what proportion of the tonnage shippers actually choose to have inspected.

SPI could, however, change its procedures. It could operate like a cooperative. That is, it would set fees high enough so that it would be virtually certain to make a profit, and then pay back the overcharge at the end of the season in the form of patronage refunds. This procedure is the standard method that cooperatives use to ensure that services are provided at cost.

To introduce patronage refunds would entail some additional expense and, before doing so, SPI should decide that the benefits are sufficient. The transfers involved are not, proportionately, very large. SPI's revenue per pound of grapes inspected in 1966 (.055 cent) amounted to only 3.6 percent of the price per pound that California growers of table grapes received in 1966 (1.63 cents). An overcharge of, say, 12 percent in such a year would deprive a grower-shipper who uses SPI only .4 percent of his sales revenue.

In short, while SPI occasionally has overcharged grape shippers, it usually has undercharged them, shifting the burden to shippers of other products, and SPI might well see how much it would cost to introduce a cooperative-type pricing system involving patronage refunds.

TABLE 3.1

SPI's Revenues and Costs for Grapes

Calendar year	Total book cost[a]	Total revenue	Revenue ÷ cost
1961	$ 173,801	$ 179,228	1.03
1962	275,308	252,052	.92
1963	278,193	245,549	.88
1964	284,654	266,002	.93
1965	348,083	336,538	.97
1966	365,569	348,831	.95
TOTAL	$1,725,608	$1,628,202	.94

[a] Total book cost is the sum of seven components: (1) compensation during inspection; (2) compensation during training, waiting, and traveling; (3) per diem allowances; (4) vehicle costs; (5) district office costs; (6) allocated general overhead (rent, parking, storage, administrative compensation); and (7) USDA charges. The accounting procedures being used were not evaluated.

Source: Records of the Bureau of Shipping Point Inspection, California Department of Agriculture.

3.22. Could Fees Profitably Be Lowered?

A price cut tends to increase quantity sold. If quantity sold increases sufficiently, the seller's total revenue will be larger at the lower price. The seller's total cost presumably also would be larger with the larger quantity, but his total cost might increase by less than his total revenue increases. If so, the price cut not only would be advantageous to the seller's customers, but also would be profitable for the seller himself. In effect, everyone would gain except the seller's competitors and their suppliers.

SPI does not have any profitable price cuts available. This conclusion is based on questionnaire results. One of the questions we asked shippers was, "How would a 50-percent cut in fees have affected this [the tonnage inspected for the shipper in 1966]?" Forty shippers answered this question. Thirty-three said that a 50-percent cut in fees would have had no effect, and seven said that it would have increased their use--one specifying a 10-percent increase, one a 50-percent increase, and five not specifying how much. From these answers, we infer that SPI's revenue would not have increased if SPI had cut its fees by 50 percent--or by any other amount. Hence, SPI could not profitably have reduced its fees.

3.23. Quantity Discounts

SPI's cost per ton inspected at a given packing shed decreases as the number of tons inspected increases. The cost per ton for 40 hours' work by an inspector is somewhat less than for 8 hours' work and much less than for 1 hour's work. The most important reason is that inspector's travel costs are spread over a larger tonnage.

It does not follow that SPI should adopt a particular pricing policy. It might charge the same fee per lug of given capacity regardless of how many lugs are inspected. This policy could be defended on the ground that it helps small shippers. It could also be attacked on the ground that it deprives large shippers of one of the economies of bigness and forces them to subsidize small shippers. Alternatively, SPI might establish a sliding scale of charges (or refunds) that closely reflects the lower cost of inspecting larger quantities per visit. This pricing policy could be defended on the ground that it helps to weed out inefficiently small shippers, encourages large shippers to have a larger proportion of their tonnage inspected, and is what competition would produce. On the other hand, a sliding scale could be attacked on the ground that it handicaps small business and makes entry on a small scale more difficult.

In fact, SPI has followed the first policy. In 1930, the Director of the California Department of Agriculture vetoed the idea of a sliding scale. He felt it would harm small shippers. SPI's standard contract does specify a minimum charge of $7 per hour, including travel time, but the minimum seldom is imposed. It is mentioned only if a shipper, in addition to having little tonnage, imposes needless waiting time on the inspector.

In 1963, a concession to large shippers was introduced. Since then, a shipper who agrees to have his entire pack inspected, and who guarantees to incur charges averaging at least $56 per day per inspector, has been charged a combination of a rate per hour and a rate per lug. If the shipper has sufficient tonnage, his cost per lug is less with the combination rate than with the standard fee.

The entire-pack condition was puzzling. SPI's Chief explained that the condition increases SPI's volume of business from shippers who choose the combination rate. More important, it holds the number of shippers who choose the combination rate down to five or six per year. Keeping the number small, he explained, "helps small shippers." At the standard fee, inspection of large shippers yields a profit and, therefore, helps to keep the standard fee, which small shippers will pay, low.

The entire-pack condition is, we think, inappropriate. Because shippers should prosper, not because they are small, but because they are efficient, we favor a pricing policy that has the objective of charging each shipper in proportion to the cost of serving him. The entire-pack condition works in the opposite direction. It is designed to make the combination rate unattractive even if a shipper has enough tonnage to warrant the $56 per day guarantee. Furthermore, the entire-pack condition may be inducing inspection that is not worth its cost. Some of the five or six large shippers who do choose the combination rate might have less than 100 percent of their packs inspected even at the lower fee if they were given the choice.

Accordingly, we suggest that SPI reconsider the question of quantity discounts.

Chapter 4

EFFECTIVENESS OF SERVICE

In this chapter, we will discuss the quality of SPI's services. We will find no deficiencies with respect to promptness of service and none with respect to accuracy of grading. We will, however, find several with respect to the appropriateness of the USDA grading system that SPI applies. Everything to be said could also be said if SPI conducted a program of Type II or III instead of Type I.

4.1. Promptness of Inspection

Which shipper to visit first often is a difficult decision. Inspectors try to compromise among several considerations: Who called first? Was an appointment made? Who has a car ready to load and a crew with nothing else to do? Would it be more economical to stop at another packing shed first? Clearly, there is ample opportunity for a shipper to feel mistreated.

To check shippers' reactions to the service they were receiving, our questionnaire asked, "How prompt is it? Please explain." Of the 49 shippers who responded to this question, 48 had no complaints. The other shipper said that once in a while service was late because SPI was short of staff. These responses become even more impressive if one realizes that shippers at times expect service on very short notice, that several respondents added that inspection at small Eastern markets often is quite slow, and that several other respondents made unsolicited and highly favorable comments concerning inspectors' courtesy and helpfulness. The customers are satisfied.

4.2. Accuracy of Certification

SPI's certification of the quality of table grapes appears to have been exceedingly accurate. The frequency of checking, data on reversals, and comments by shippers all support this conclusion.

Inspectors' work is checked frequently. The Chief of the Bureau identified for us 70 inspectors who might have certified table grapes. We sent these 70 inspectors a questionnaire. In it, we asked how often their work was checked. Eleven of the 70 responded to this question, and 10 said at least one phase of their work was checked daily.

Occasionally, the grades assigned by SPI's inspectors are checked at the receiving point. Most California table grapes are sold on a "f.o.b. usual terms" basis. Under this arrangement, the price is agreed on before shipment, the shipper takes care of loading the product, and the receiver pays shipping costs and bears the risk of any delay or deterioration in transit not caused by shipper. (The receiver may recover from the carrier if loss was the carrier's fault.) The receiver ordinarily examines the shipment on arrival. He is entitled to reject the shipment and to withhold payment if, and only if, the product did not, when shipped, comply with the terms of the contract. The receiver may not reject solely because of condition on arrival since condition (e.g., amount of rot) may have changed enroute; if the receiver does so, he is liable to the shipper for breach of contract. The receiver may, however, reject a shipment whose maturity, quality, berry sizes, etc., are unsatisfactory, since these characteristics supposedly do not change enroute. For the shipper, SPI's certificate serves as evidence that, at the time of loading, the product had the characteristics and condition stated in the certificate.

Reinspection at the receiving point by the Federal-State Inspection Service may occur either at the request of a shipper whose shipment was rejected or at the request of a dissatisfied receiver. Receiving-point inspection by the Service duplicates shipping-point inspection except that the receiving point sample is twice as large. A reversal entitles the receiver to reject.

Accordingly, some evidence can be obtained on the frequency of misgrading--or rather of overgrading--by SPI by comparing the number of reversals to the number of shipping-point inspections. (Note that it would be a mistake to compare the number of reversals to the number of receiving-point inspections, since SPI presumably did not overgrade when there was a shipping-point inspection but not a receiving-point inspection.) Table 4.1 presents the available data.

Judging by Table 4.1, SPI's record of avoiding overgrading virtually defies improvement. Only two of 123,371 certifications were reversed in the six years ending in 1967.

Table 4.1, however, may exaggerate SPI's accuracy. Shippers' responses to the questionnaire paint a less favorable picture--but still an impressive one. To learn shippers' reactions to this aspect of SPI's performance, we asked, "How accurate is it?" Forty-eight shippers answered the question. Thirty-seven of the 48 made favorable comments. The other 11 said that the degree of accuracy varies with the inspector, inexperienced ones being somewhat unreliable. No

TABLE 4.1

Grape Certifications Versus Reversals for SPI

Calendar year	Number of certifications of table and juice grapes	Number of certificates reversed at receiving point
1962	21,510	0
1963	19,354	1
1964	19,640	0
1965	22,798	1
1966	22,332	0
1967	17,737	0
TOTAL	123,371	2

Source: Records of the Bureau of Shipping Point Inspection, California Department of Agriculture.

shipper, however, said that SPI was inaccurate, and none made comments that were more than mildly adverse in this respect.

Shippers were also asked, "Has their certification of your table grapes ever been disputed? If your answer . . . is yes, what happened?" Fifty shippers responded to these questions. Eighteen said that at one time or another they had had disagreements with receivers. Only four, however, said that they had had to make adjustments in price with the buyers; only two said that SPI's certification had been reversed at the receiving point; and none indicated that SPI was responsible for their difficulties.[1/] Indeed, two shippers recounted incidents in which SPI's judgment ultimately was borne out. One had suffered a reversal on reinspection, had called for a second reinspection, and had this second reinspection confirm SPI's original evaluation. The other shipper had had a car rejected by a chain store, had sent the car on to New York, had had the car reinspected in New York with the assistance of the Head of the Inspection Service from Washington, D.C., and had SPI's original judgment confirmed.

In terms of accuracy as well as promptness, then, the quality of SPI's service seems to be excellent.

4.3. The Grading System

We will discuss three aspects of the official grading system for table grapes--grade names, grade widths, and grade specifications. In each respect we will find deficiencies. Then we will discuss the machinery for obtaining changes.

[1/] That two shippers suffered reversals does not seem to be compatible with the indication in Table 4.1 that SPI had only two reversals in seven years. Compatibility requires something quite unlikely--that the sample happened to include every shipper who had suffered a reversal from 1962 through 1967, and that the two shippers who said that they had suffered reversals had only one reversal each. However, the two indications can be reconciled by supposing that the two shippers were using a different definition of reversal than SPI used. It is possible that the basis of sale for these two shippers was not "f.o.b. usual terms" but "f.o.b. inspection and acceptance arrival." If so, the receivers were entitled to reject on the basis of condition as well as quality. In addition, rejection may have occurred because of characteristics such as berry size. If the receivers did reject on a basis other than quality and were sustained by reinspection, the shippers may have regarded the cases as reversals, while SPI did not. In any event, even the information less favorable to SPI indicates high accuracy in grading.

4.31. Grade Names

For many agricultural products, the official grade names are meaningless and even deceptive to people who buy at retail. Table grapes are no exception.

There are six grade names in use. Four are official names. They are, from highest to lowest, "U.S. Fancy Table Grapes," "U.S. Extra No. 1 Table Grapes," "U.S. No. 1 Table Grapes," and "Unclassified."[1] The other names derive from the fact that SPI and industry people subdivide U.S. No. 1 Table Grapes into three parts. These parts are called, from highest to lowest, "Defects Well Within Tolerance," "Defects Within Tolerance," and Defects Average Within Tolerance."[2] The various names usually are abbreviated. For example, a lot that qualifies for the fifth highest classification usually is referred to as "U.S. No. 1 Average Within." A sign in a retail store might further abbreviate the name to "U.S. No. 1."

For consumers, these grade names are meaningless. The names do not indicate how the several grades rank. Furthermore, consumers cannot rely on their experience with other commodities. Different sets of grade names have been adopted for different types of commodities, and commodities with the same set of grade names spread over the several grades in different proportions.

The present grade names also are misleading. It is misleading to designate the third highest quality "U.S. No. 1." It is misleading to allow omission of "Average Within" for a lot that barely qualifies for "U.S. No. 1." Finally, it is misleading to apply "U.S. No. 1" to lots of very low eating quality--as is happening according to a prominent grower-shipper whom we interviewed. He asserts that a lot can qualify for "U.S. No. 1" because it has no defects and yet be virtually unfit to eat.

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[1] According to the rules, "The term 'unclassified' is not a grade within the meaning of these standards, but is provided as a designation to show that no grade has been applied to the lot" (U.S. Department of Agriculture, Agricultural Marketing Service, *United States Standards for Grades of Table Grapes, European or Vinifera Type*, Effective August 15, 1960 as amended August 26, 1961 and June 18, 1964, p. 4). Nevertheless, "Unclassified" is applied to grapes that do not make U.S. No. 1, so we regard the term as a grade name.

[2] SPI's subdivision of a grade into "Well Within," "Within," and "Average Within" is based on tolerances both for individual containers and for the average over all containers sampled. For a lot to be "Well Within," no individual container may exceed that tolerance specified by the USDA for the grade involved and, in addition, the average over all containers may not exceed one-half of the tolerance for the grade. For a lot to be "Within," neither individual containers nor the average may exceed the specified tolerance. For a lot to be "Average Within," no individual container may exceed twice any tolerance that is less than 10 percent or 1.5 times any tolerance that is 10 percent or more, and the average may not exceed the grade tolerance.

The use of meaningless and misleading grade names reflects a one-sidedness in the process by which grade names are selected. Producers do not like grade names that suggest that they are selling inferior products, and consumer interests are not represented in the selection process. The social benefits of SPI's activities would be greater if consumer interests took precedence with respect to grade names.

4.32. Grade Widths

The width of grades is too large and the number of grades is too small if lots with the same grade command different prices or, more generally, if traders often subdivide the grades in dealing with each other. For table grapes, subdivision of the official grades is standard practice.

Our questionnaire explored the relation between grades and prices. It stated, "I assume that your grapes are not of uniform quality. Does inspection contribute to your getting prices which reflect quality differences?" The questionnaire also said, "I assume that the average quality of your grapes differs from that of others. Does certification contribute to your getting prices which reflect these quality differences?"

Fifty shippers responded to these questions. Nineteen denied that inspection helps to relate price to quality among their own grapes, and 24 denied that inspection helps as between their grapes and other shippers' grapes. Some of the respondents who denied that inspection helps cited factors other than imperfections in the grading system. (For example, two respondents explained that sellers with good reputations do not need certification. One respondent said that chain stores rely on their own inspectors.) Six respondents, however, referred to the grading system itself. They said that the existing grades simply are too wide to help relate price to quality. One shipper explained that there is often a $1 per box difference between the prices he receives for two boxes of the same grade. Two shippers added that they would increase their use of SPI if the grading system were improved.

Apparently, grades could be narrowed in several directions. One shipper mentioned that stricter tolerances are needed with respect to color; he said that anything from black to pink is being construed as red when red is required. Several shippers said that minimum berry size should be increased, especially for the Thompson Seedless and Perlette varieties. Clearly, grade widths need reconsideration.

4.33. Grade Specifications

Grade specifications are inappropriate if they change from year to year to "fit the crop." The specifications behind the trademarks of many shippers of fruits and vegetables do change from year to year. SPI, in contrast, maintains its standards regardless of how much of the crop falls into each grade.

Grade specifications also are inappropriate if they give little or no weight to product characteristics that are important to distributors or consumers, or if they give heavy weight to product characteristics that are not important. Both of these problems apparently do exist with respect to the official grade specifications for table grapes.

We asked shippers, "Should any change be made in grade specifications? If your answer . . . is yes, what changes would you recommend and why?" Forty-four shippers responded to this question, and 21 said that changes are needed. Judging by their comments, a number of changes are needed.

Some lot characteristics apparently are receiving excessive weight. For example, too much attention, we were told, is being given to the size of bunches, as distinct from the size of berries. Part of the problem seems to stem from a failure to revise grade specifications to recognize the effects of gibberellic acid, whose use has increased berry sizes and reduced the ratio of sugar to acid. Conversely, some lot characteristics apparently are receiving insufficient weight. For example, meatiness, we were told, should receive more attention. At minimum, SPI's certificate could provide supplementary information about such characteristics.1/

4.34. Obtaining Changes

SPI cannot itself change the official grading system. SPI can, however, be a catalyst.

1/ One shipper said that he often has had difficulty concerning alleged short weight. He suggested that SPI's certificate also should certify weight. Another shipper said that, in fact, he had used inspectors for this purpose.

Tradition requires that the industry initiate action. Interested sellers or buyers must approach the USDA and request a change. After receiving the request, the Consumer and Marketing Service in Washington, D.C., would send a specialist to discuss the matter with members of the industry, with SPI, and with experiment station personnel. He would then draft new grade specifications. These would be distributed to interested parties for comment. The process would be repeated until a final version was ready. Probably it would take a USDA man about six months to prepare an acceptable version. The final version would be published in the Federal Register and, after 30 days, become effective.

Although dissatisfaction with the current grading system is widespread, it might be difficult to obtain industry-wide agreement on specific changes. For example, conflicts of interest exist with respect to standards of maturity. Shippers in Coachella Valley, where grapes ripen relatively early, try to sell their grapes as soon as possible--that is, while prices still are relatively high. The marketing order for desert grapes requires that their grapes meet all specifications for U.S. No. 1 except maturity, and they often ship grapes before they qualify for U.S. No. 1 as the maturity requirement presently is interpreted. These shippers would prefer a less stringent interpretation so that they could claim to be selling U.S. No. 1. Many San Joaquin Valley shippers, on the other hand, contend that consumers who obtain untasty grapes will buy fewer grapes later, and that immature grapes, therefore, should not be sold at all.

While a consensus might not emerge, it does seem that grade names, grade widths, and grade specifications need reexamination. We believe that greater effectiveness could be obtained for the same cost.

Chapter 5

COST OF SERVICE

In this chapter, we will try to judge whether the cost of SPI's service could be lower than it is. In section 5.1, we will consider whether other government agencies could provide the same quality of service at lower cost. Everything said in this section would apply even if SPI conducted a Type III program. In sections 5.2 and 5.3, we will consider whether there are other years or other organizations whose costs per unit of output are comparable to SPI's. Since such comparisons are possible only if outputs are measurable, these sections would not apply to a Type III operation. Finally, in section 5.4, we will explain that, although we did not undertake detailed operations research, we can judge from inspectors' comments that there is little room for improvement.

5.1. Alternative Governmental Agencies

We want to judge whether costs would be lower if SPI's work were done by other agencies of government--possibly because they are better organized or because they could spread overhead. There is no reason to think so.

We asked SPI's customers, "Could certification be given equally well by another agency which visits you?" Of the 39 shippers who responded to this question, 32 said "no," and 7 said "yes." One of the seven who said "yes," really meant "no," since he added that certification by another agency would not be as valuable--it would lack the respect accorded certification by SPI--and only four of the seven mentioned a specific alternative. Each mentioned standards inspectors. While standards inspectors do work at shipping points, we do not think that it would be appropriate for them to take on SPI's grading activities. Let us see why.

Standards inspectors are law enforcement officers whose salaries are paid from public funds. Each inspector has a territory to cover and drops in on shippers uninvited. The inspector is supposed to see that substandard lots are not shipped out of the county. (Such lots may be sold within the county, however, and standards inspectors occasionally see lots that they have rejected offered for sale at nearby roadside stands.) The standards pertain to maturity (something which the inspector may infer from size, color, chemical content, etc.) and to condition, and are established by state law.[1]

SPI's inspectors, in contrast, have no police power, charge for services rendered, try to be available when needed, and come only when invited. If SPI's grading function were to be assigned to the standards inspectors, the invitations might dry up. Shippers would be less inclined to have their products graded if the man doing the grading had the power to prevent shipment. As long as grading remains voluntary, therefore, it does not seem reasonable to have it done by standards inspectors.

5.2. Comparisons Over Time

The character of SPI's grape inspection work has been quite stable over time, and its grape tonnage has grown. Accordingly, if SPI's cost per ton inspected had risen more rapidly than the prices of SPI's inputs, one might infer that inefficiencies had crept in over the years.

Table 5.1 contains all relevant data that were available. The data pertain to table grapes and juice grapes combined. However, the average cost for the two combined is approximately the same as the average cost for table grapes alone, since the two inspection processes are quite similar.

It is evident from Table 5.1 that SPI's labor cost per ton and its total cost per ton have risen in recent years, and also that the increase in labor cost accounts for most of the increase in total cost. It is also evident, however, that labor time per ton has held quite constant. Consequently, increased salaries account for most of the increase in costs that has occurred. It appears that the degree of efficiency that SPI had attained in 1961-1963 was maintained in 1965-1966.

5.3. Comparisons with Other Organizations

We considered three possible cost comparisons--with SPI's counterparts in other states, with the Dried Fruit Association, and with Sunkist. None proved helpful. Let us explain why.

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[1] We are indebted to John Mamer for the information in this paragraph.

TABLE 5.1

SPI's Unit Costs for Grape Inspections

Calendar year	Inspection labor per ton inspected[a]	Travel, waiting, and training time per ton inspected[b]	Labor cost per ton inspected	Total cost per ton inspected	Thousand tons inspected[c]
	hours				
1961	0.17	--[d]	--[d]	$0.93	186
1962	0.16	0.06	$0.64	1.00	275
1963	0.20	0.02	0.67	1.08	257
1964	0.18	0.02	0.66	1.06	268
1965	0.18	0.02	0.70	1.11	313
1966	0.18	0.02	0.74	1.15	317

a/ Inspectors report their time by product.

b/ Inspectors allocate their travel and waiting time by product.

c/ Data were recorded in terms of "carlot equivalents." SPI estimates that one carlot was equivalent to 13.5 tons for 1961-1965 and 15.9 tons for 1966.

d/ Not available.

Source: Calculated from the records of the Bureau of Shipping Point Inspection, California Department of Agriculture.

Comparable data for other states were not available. Arizona is the only other state with shipping-point inspection of European-type grapes, and Arizona inspects only 500-600 cars of grapes per year, that is, only about 2.5 percent of SPI's volume. The official inspection agency in Arizona is the Cattlemen's Association, and grape inspection appears to be incidental to its major activities. In any event, we could not obtain any cost figures for Arizona.

Comparable data pertaining to DFA also were unavailable. Inspections conducted by DFA are not like SPI's inspection of grapes. Hence, there is no basis for comparing DFA's actual average cost with SPI's. Proceeding hypothetically did not work either. DFA was asked to estimate what it would cost them to do SPI's work. Never having studied the matter, DFA was unwilling to make the estimate.

Contacts with Sunkist were almost as unproductive. Sunkist officials asserted that it was more economical for them to do their own inspecting. They were, however, willing or able to disclose only one cost figure--their average cost of inspecting oranges in fiscal 1966-1967. The figure for that year was 0.63 cent per carton, or about $6.65 per railroad car. During the same period, SPI was charging about $16.00 per railroad car. From this, one might infer that SPI was less efficient than Sunkist. The inference, however, is not warranted. The character or quality of Sunkist's and SPI's inspections were quite different. Sunkist's inspectors do not provide continuous inspection. They do spot checks, usually dropping in twice a day at any one packing house. In addition, Sunkist may have been reaping economies of scale. During the period involved, Sunkist inspected 63,688 carlots, while SPI inspected only 2,468. SPI's Chief told us that SPI could have inspected Sunkist's oranges at an average cost considerably below the fee that SPI was charging for its existing work on oranges. However, since he had never studied the matter in depth, he could not give a precise estimate. Hence, the information available warrants no conclusions concerning SPI's efficiency in the inspection of oranges and *a fortiori*, no conclusions concerning SPI's efficiency in the inspection of table grapes. Our attempt to compare SPI's costs with Sunkist's costs, like our attempts to compare with DFA and with other states, were inconclusive.

5.4. Operations Research

We wanted to undertake a detailed investigation of SPI's operations. We might, for example, have examined inspectors' routes, per diem allowances, and leasing of quarters (on which State rules apparently are creating problems for SPI). To do so would have illustrated how economic analysis can identify ways to cut program costs. Time limitations, however, precluded this approach.

Instead, we decided to raise the subject with SPI's inspectors. In the anonymous questionnaire that we sent to the inspectors, we asked, "Do you have any suggestions as to how the Bureau can be made more effective and more efficient with regard to its grape inspection service?" We also asked, "Do you have any suggestions regarding an improvement in the personnel policies of the Bureau?"

The picture that emerges is very different from the conventional image of a government-owned monopoly. To a man, the 11 inspectors who responded praised their operation and its efficiency. Except for some suggestions concerning the relative status of seasonal and regular employees, the inspectors did not see any way to improve SPI's performance. Several added that SPI had to be as cost conscious as possible because it had to "pay its way." According to some people who might know best, then, SPI's efficiency virtually defies improvement.

Chapter 6

COSTS OF EXPANSION

Economic analysis can produce estimates of the costs or savings associated with various expansions or contractions in the scale of program activities. In some cases, economic analysis also can quantify the change in benefits that would result. To illustrate, we wanted to consider the possibility of expanding SPI's activities to include vineyard inspection of wine grapes. Time limitations prevented us from doing so.

We should add that there are few functions that SPI's inspectors could be expected to perform during their visits that they are not already performing, although some shippers may need to be informed that certain services are available. The questionnaire sent to shippers asked, "Are there additional services which you think it would be reasonable to require of the inspectors . . . ?" Only one shipper said "yes." He mentioned field testing at the time of harvest. SPI's Chief, however, told us, "We do make information checks of produce in the field; however, for obvious reasons, this is not official or final. (We base our certification on the finished product.)" Corroborating this statement is the fact that a shipper responding to another question mentioned that SPI's inspectors had checked his fruit in the field. Apparently the first shipper simply did not know that the service was available. In the next chapter, we will see that the inspectors informally render other services too.

Chapter 7

THE BENEFIT-COST RATIO

In this chapter, we will identify the benefits of SPI's table grape inspection activities and try to decide whether, and by how much, the ratio between the dollar value of program benefits and the dollar value of program costs exceeds one.

Identifying benefits will be the subject of section 7.1. This section contains all that we could say if there was no way to place a dollar value on SPI's outputs. In fact, SPI sells its services, so we can do more than enumerate benefits. We can estimate their dollar value, using methods applicable to privately produced outputs.

We will approach this task in four steps. In section 7.2, we will define measures of the dollar value of program benefits--one measure for gross benefits and one measure for net benefits. In section 7.3, we will show that these measures of benefits correspond to (but are somewhat less than) areas under the curve that represents grape shippers' collective ordinary demand for SPI's service. In section 7.4, we will present our estimate of the collective ordinary demand for SPI's service that actually prevailed in 1966. Finally, in section 7.5, we will present our numerical estimate of shippers' collective gross and net benefits in 1966, together with our estimate of the benefit-cost ratio.

7.1. Identifying Benefits

We were able to identify and to obtain evidence for four beneficial effects: opening markets, reducing unwarranted rejections, relating price to quality, and assisting in quality control.

One benefit of SPI's activities is to facilitate entry. Certification by SPI enables new or small shippers to compete with large, established shippers on more equal terms. This helps to link regional markets with each other, helps to weed out inefficient competitors, and contributes to equalizing economic opportunity.

How do we know that entry is facilitated? We asked shippers, "Does inspection give you better access to markets? That is, does it give you a larger number of potential buyers; does it contribute to your getting better prices;

does it enable you to get more favorable marketing arrangements? Please explain." Forty-nine shippers answered this question, and 27 said that use of SPI does give them better access to markets. Four respondents mentioned that, in particular, they could not ship to Canada or the military without SPI certification. Of course, if using SPI gives even one shipper better access to markets, then SPI can be credited with this benefit. One shipper said explicitly that he could not market his grapes without using SPI.

A second benefit of inspection is to reduce the frequency of unwarranted rejections, the number of disputes, and the amount of litigation with buyers and transportation companies. We asked, "Does it reduce dishonest rejection by receivers?" Thirty-six of 46 respondents said "yes." From additional comments, however, it was evident that shippers still have many unpleasant experiences. We commented on this problem earlier (section 4.2).

A third benefit is to enhance the incentive and the reward for shipping higher quality grapes. As mentioned above (section 4.32), we asked shippers whether certification by SPI helped to relate price to quality. A majority answered in the affirmative. At least in the view of these shippers, certification was helping the price system to function in a way that economists like.

A fourth benefit is quality control, information, and advice. We asked shippers, "Are there benefits other than the inspection certificate itself? Please explain." Of 47 shippers who responded to this question, 36 said "yes." Eighteen said that SPI's inspectors are very helpful in seeing that packers put grapes in the proper boxes. Indeed, several shippers said that improved quality control is the principal reason that they use SPI. The mere presence of an inspector, they said, keeps workers on their toes. A number of shippers also mentioned that SPI's inspectors are a valuable source of news about competitive conditions, information about packing methods used by other shippers, and suggestions concerning storage, unnoticed defects, decay in transit, etc.

The benefits we have enumerated accrue primarily to the shippers whose grapes are inspected, and most of our respondents feel that they are getting their money's worth. The feeling, however, is not unanimous. One shipper said that inspection is ". . . no help at all. A big waste of money." He subscribes only because inspection is mandatory under the marketing order for desert grapes.

The foregoing comments would complete our discussion of benefits if SPI's outputs were not measurable. If outputs were measurable but not susceptible to valuation, we could, in addition, indicate the level of output. This we already have done (see Tables 4.1 and 5.1). In fact, SPI sells its outputs, so we can proceed to estimate the dollar value of direct program benefits, using methods that ordinarily are applied to privately produced outputs.

7.2. Our Measure of Dollar Benefits

We want to measure the dollar value of the direct benefits of SPI's grape inspection activities. Since the direct benefits seem to accrue primarily to the shippers whose grapes are inspected, we will confine our attention to the dollar value of SPI's inspection activities to those shippers. We will focus on the most recent year for which data are available, namely, 1966.

The dollar value of SPI's services to the shippers whose grapes were inspected in 1966 was larger than the amount of money that these shippers actually paid SPI. The reason is that SPI did not vary its prices in the manner of a discriminating monopolist, that is, did not vary its fees in an attempt to charge each customer as much money as he would have been willing to pay for the services that he received. Accordingly, it would not be appropriate to measure the dollar value of SPI's services by the amount of money that shippers actually paid for them.

Instead, we will measure the dollar value of SPI's services by the amount of money that shippers were willing to pay for the services they received. This sum of money we will call shippers' collective gross benefit. It will serve as our estimate of the dollar value of program benefits. In addition, we will refer to the difference between shippers' collective gross benefit and the money they actually paid SPI. This difference we will call shippers' collective net benefit.

Let us be more precise. We define the gross benefit of SPI's services to all shippers collectively as the sum, over all shippers, of the gross benefit to each shipper. The gross benefit to any one shipper we define as the largest amount of money that the shipper would have been willing to pay SPI for the inspection services that he actually received (if other grape shippers also had to pay the same higher fee). That is, a shipper's gross benefit is the largest amount of money that he could have paid for the services he received without being worse off (in his own judgment) than he would have been if SPI had provided no services at all to grape shippers (perhaps because of a work stoppage). The net benefit of SPI's services to all shippers collectively, we define as the sum, over all shippers, of the net benefit to each shipper. The net benefit to any one shipper, we define as the difference between his gross benefit and his actual payments to SPI.

Our measures are standard. What we are calling net benefit also is known as buyers' Marshallian surplus.[1/] By either name, it refers to the extra amount of money that buyers would have been willing to pay for the services that they actually received.

These measures of benefits, we should add, relate to the actual situation. If anything had been different--whether grape prices, harvesting costs, marketing orders, Canadian regulations, or whatever--the amount of money that shippers would have been willing to pay for SPI's services presumably also would have been different. Gross and net benefits, as we have defined them, take the actual state of affairs as given.

Our first task is to show how these measures of benefits relate to obtainable information--in particular, to information about shippers' demand for SPI's services. The task is, unfortunately, lengthy and somewhat complicated. Readers who are not interested in economic theory should skip to section 7.4.

7.3. Relation of Measures of Benefit to Demand Curves

In this section, we will show that shippers' collective gross benefit is equal to the area under their collective compensated demand curve from the quantity zero to the quantity they actually purchased, and is less than or equal to the area under their collective ordinary demand curve between these two quantities. We will also show that shippers' collective net benefit is equal to the sum of the positive area and the negative area between their collective compensated demand curve and a line at the level of the actual price from the quantity zero to the quantity actually purchased, and is less than or equal to the area between their collective ordinary demand curve and a line at the level of the actual price.

[1/] Patinkin, Don, "Demand Curves and Consumer's Surplus," in Carl F. Christ, et al., *Measurement in Economics; Studies in Mathematical Economics and Econometrics in Memory of Yehuda Grunfeld*, Stanford, California: Stanford University Press, 1963, pp. 83-111.

The section has two major parts. In subsection 7.31, we will see that, for a special case, we can refer merely to ordinary demand curves; we do not need the concept of a compensated demand curve. In subsection 7.32, we will consider the more complicated general case.

Throughout the section, we will assume that SPI charged a single fee in 1966, such as 0.55 cent per 10 pounds, which was SPI's actual revenue per 10 pounds of table and juice grapes. In fact, SPI had a schedule of fees. It charged 0.8 cent per lug for lugs whose capacity was up to 10 pounds, 1.3 cents per lug for lugs whose capacity was 11 to 23 pounds, and 1.5 cents per lug for lugs whose capacity was 24 pounds or more. We cannot incorporate this complication in the analysis. In later sections, we will circumvent the problem.

7.31. Quantifying Benefits with Yes or No Ordinary Demands

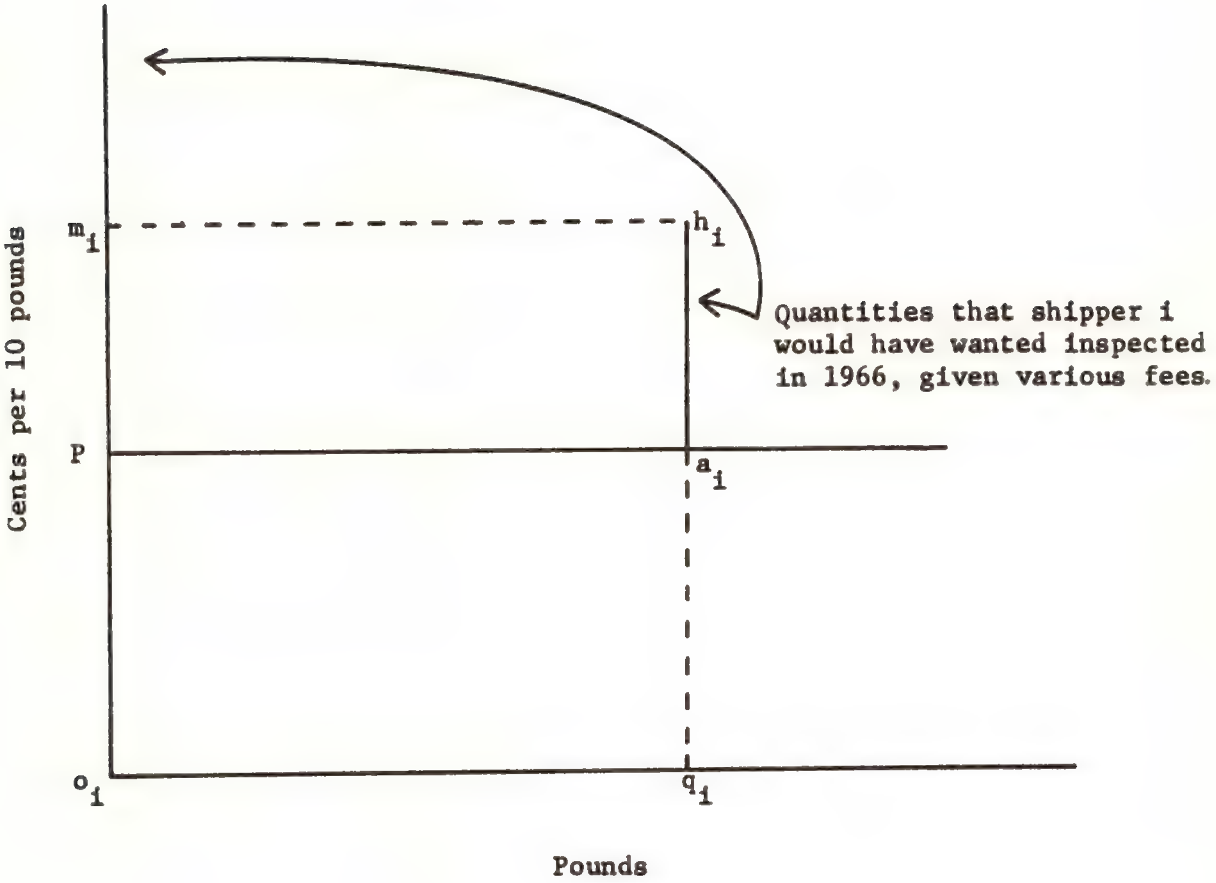
In this subsection, we will show that, if every shipper's ordinary demand for SPI's services was what we will call a yes or no demand, then shippers' collective gross and net benefits were equal to areas under their collective ordinary demand curve. We will start by explaining the property that their individual ordinary demands must have had, and then go on to identify the areas that then represent their individual and collective gross and net benefits. In subsection 7.32, we will consider the more complicated general case, in which shippers have, not yes or no, but sloping ordinary demands.

7.311. The Concept of a Yes or No Demand

Suppose that, for every shipper who had SPI inspect his grapes in 1966, the decision to purchase SPI's services was a yes or no matter. That is, suppose that, for each user, there existed a fee level with the property that, if SPI's charge per 10 pounds had been raised above this level, the shipper would not have used SPI, but if SPI's charge merely had been raised toward this level, the shipper would have had the same tonnage inspected. This assumption implies something about a shipper's ordinary demand (we say ordinary demand because we will soon refer to two other kinds of demands, namely, an all or none demand and a compensated demand). The relevant part of a shipper's ordinary demand curve then would have been vertical. It would have looked like the line segment $a_i h_i$ in Figure 7.1.

FIGURE 7.1

Hypothetical Ordinary Demand of Shipper i in 1966



The symbols in Figure 7.1 need explanation. P represents the price (fee) per 10 pounds that SPI actually received in 1966. q_i represents the quantity (number of lugs) that the grape shipper in question (shipper i) chose to have inspected in 1966. m_i represents the maximum fee that shipper i would have been willing to pay to have this quantity inspected. Point a_i represents shipper i's actual price-quantity combination. Point h_i represents the price-quantity combination that shipper i would have had if SPI's fee had been m_i. The demand curve as a whole shows what quantity of inspection services shipper i would have chosen in 1966 if SPI's price of inspection to all shippers had been at various alternative levels.

7.312. Shippers' Individual Benefits with Yes or No Ordinary Demands

For a shipper whose ordinary demand had the shape shown in Figure 7.1, the analysis of gross and net benefits is direct. Consider first his gross benefit.

His gross benefit was the largest amount of money that he would have been willing to pay SPI for the inspection services that he actually received in 1966 (assuming that SPI's fee to other shippers increased by the same amount that SPI's fee to him rose). This amount of money is the product of the quantity that the shipper in question had inspected times the maximum fee that he would have paid for the inspection service that he received. In Figure 7.1, the amount of money is the rectangular area $m_i\ h_i\ q_i\ o_i$, that is, is the area under shipper i's ordinary demand curve between a quantity of zero and a quantity of q_i. This was shipper i's gross benefit.

Shipper i's net benefit was, of course, smaller. The amount that he paid SPI was the product of this actual quantity (q_i) times SPI's actual price (P). In Figure 7.1, this actual payment is the rectangular area $Pa_i\ q_i\ o_i$. Accordingly, the difference between shipper i's gross benefit and his actual payment appears in Figure 7.1 as the rectangular area $m_i\ h_i\ a_i$ P, that is, as the area between his ordinary demand curve and a line at the level of the actual price. This was shipper i's net benefit.

Now let us consider the gross and net benefits of all shippers collectively, maintaining the assumption that each of them had a yes or no ordinary demand.

7.313. Shippers' Collective Benefits with Yes or No Ordinary Demands

The ordinary demand for SPI's services of all shippers collectively was a horizontal sum of the ordinary demands of the individual shippers. That is, the quantity assigned to any price by the collective ordinary demand is the sum of the quantities assigned to that price by the individual ordinary demands. If the latter are vertical, as in Figure 7.1, the collective ordinary demand was a step function, like that shown in Figure 7.2.

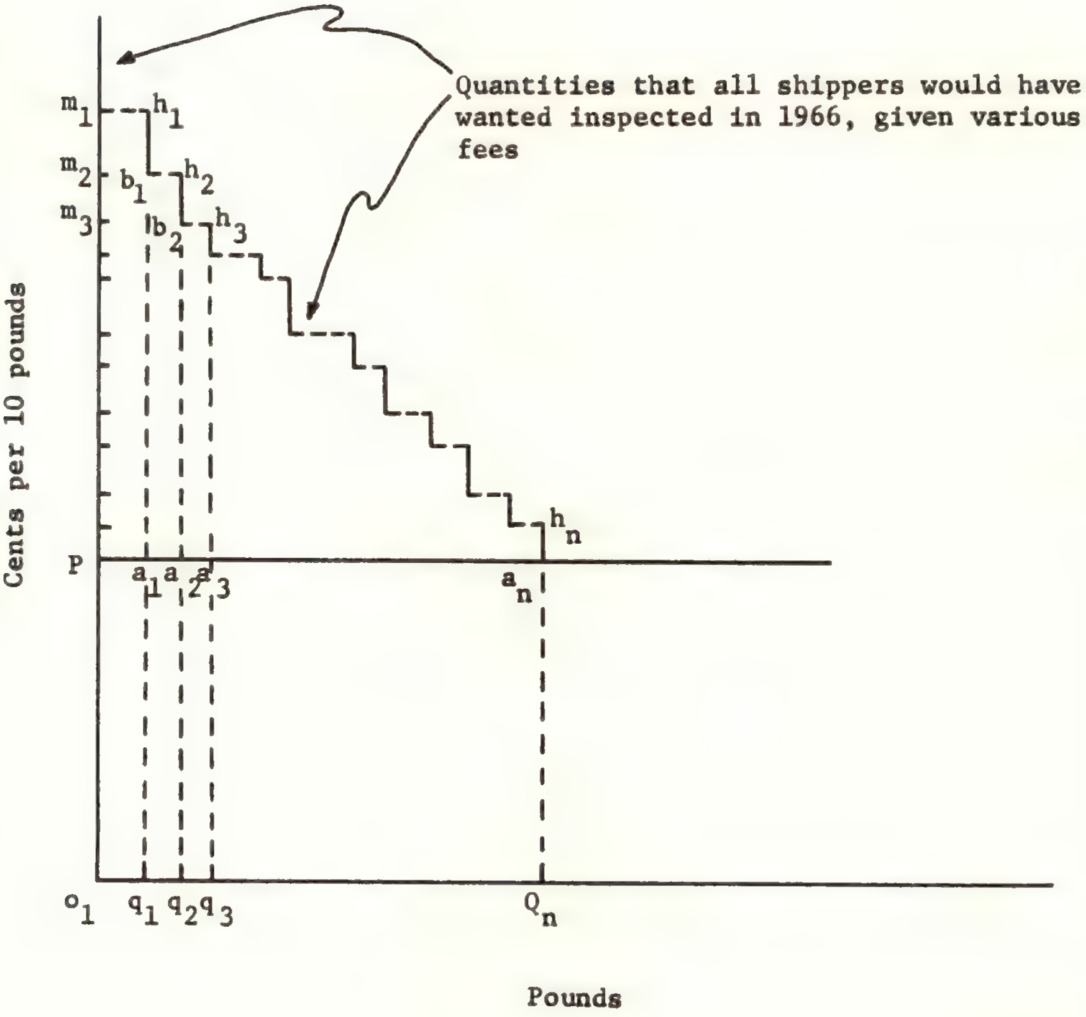
Being a sum, the collective ordinary demand will reflect the character of the individual ordinary demands. The height of the top step (m_1) represents the highest of the various shippers' maximum fees. The width of the top step (q_1) represents the tonnage that this shipper had inspected in 1966. (If a number of shippers had the same maximum fee, the width of the step would be their collective tonnage.) The height of the second step down (m_2) will be the second highest of the shippers' maxima, and the width of the second step ($Q_2 - q_1$) will be this second shipper's tonnage, that is, q_2. Other steps will show the maxima and the tonnages of the other shippers. Q_n represents the combined tonnage of all shippers, that is, $Q_n = \sum_{i=1}^{n} q_i$, where n denotes the number of grape shippers who used SPI in 1966.

The areas that measure gross and net benefits to individual shippers reappear in Figure 7.2. For the shipper whose maximum fee was highest, gross benefit, which was the area $m_i\ h_i\ q_i\ o_i$ in Figure 7.1, reappears as the area $m_1\ h_1\ q_1\ o_1$ in Figure 7.2. His net benefit, which was the area $m_i\ h_i\ a_i\ P$ in Figure 7.1, reappears as the area $m_1\ h_1\ q_1\ P$ in Figure 7.2. For the shipper with the second highest maximum fee, gross benefit reappears as the area $b_1\ h_2\ Q_2\ q_1$, and net benefit reappears as the area $b_1\ h_2\ s_2\ a_2$. Analogous areas occur for the remainder of the n shippers.

Collective gross and net benefits, accordingly, can be read off of Figure 7.2. The sum, over all shippers, of the gross benefit to each shipper is the area under the collective ordinary demand curve between a quantity of zero and a quantity of Q_n, namely, the area $m_1\ h_1\ b_1\ h_2\ b_2\ h_3\ h_n\ Q_n\ o_1$. This was the collective gross benefit. Similarly, the sum, over all shippers, of the net benefit to each shipper is the area $m_1\ h_1\ b_1\ h_2\ b_2\ h_n\ a_n\ P$, which is the area between the collective ordinary demand and a horizontal line at the price P. This was the collective net benefit.

FIGURE 7.2

Hypothetical Ordinary Demand of All Shippers in 1966



We can summarize this section (7.31) in one sentence: If every shipper's ordinary demand for SPI's services was a yes or no demand, then we can measure shippers' collective gross and net benefits by areas under their collective ordinary demand curve.

Some of the shippers whose grapes SPI inspected in 1966 may have had yes or no demands. Two groups are the likeliest candidates. One group consists of the shippers who were subject to the marketing orders for California table grapes. For them, inspection was mandatory on all grapes marketed. The other group consists of the shippers who would not have reduced the tonnage they had inspected even if SPI's fee schedule had doubled. Forty-four shippers, 33 of whom were not subject to a marketing order, responded to this part of our questionnaire; 22 said that a doubling of fees would have had no effect, and 5 were not sure how they would have reacted.

On the other hand, many shippers evidently did not have yes or no demands. The other 17 of the 44 shippers said that they would have reduced their quantities inspected but, apparently, not to zero. If the responses of these 17 shippers were accurate, they did not have yes or no demands. Moreover, even shippers who were subject to the marketing orders could lawfully have reduced their quantities inspected by reducing their quantities shipped, and if SPI's fee schedule had risen to an inordinately high level, the administrative committees might even have rescinded the requirement of inspection. The assumption that every shipper's ordinary demand is a yes or no demand must be relaxed.

7.32. Quantifying Benefits with Sloping Ordinary Demands

In this section, we will show that the areas that we have identified under shippers' collective ordinary demand curve are, in the general case, merely upper bounds on shippers' collective gross and net benefits. We will start by describing individual demands in the general case. Then we will show that the areas identified in the previous section exceed or equal shippers' actual benefits in the general case.

7.321. Individual Demands in the General Case

The general case is not free of assumptions, but the two it involves are very plausible. The assumptions are, first, that the quantity that any shipper would have wanted SPI to inspect would not have been larger if SPI had increased its fee; and, second, that a reduction in any shipper's net worth would not have increased the maximum fee that he was willing to pay to have any quantity inspected. In other words, for every shipper, the price elasticity of his demand for SPI's services was nonpositive, and the income elasticity was nonnegative, at all relevant prices and incomes.

These assumptions are consistent with a wide variety of ordinary demands. That is, there are many ways in which a shipper's quantity might have responded to a change in SPI's fee. The ordinary demand shown in Figure 7.1 is one possibility. The relation shown in Figure 7.3 is another possibility. The latter contains a number of features that might have existed--kinks, horizontal discontinuities, and a second derivative that is negative, zero, or positive, depending on the region. The most important feature of the relation in Figure 7.3, however, is that, unlike the demand curve in Figure 7.1, it indicates that the shipper's quantity would have been smaller if SPI had raised its price, even if the new price was still below the maximum fee that the shipper would have paid (m_i).

7.322. Shippers' Individual Benefits with Sloping Ordinary Demands

For a shipper whose quantities would have been smaller if SPI's fee had been higher, our previous measures will, to some extent, overstate both his gross and net benefits. The area under shipper i's ordinary demand curve from a quantity of zero to a quantity of q_i will overstate his gross benefit, and, as a result, the area between his ordinary demand curve and a line at the level of the actual price will overstate his net benefit. To see why is somewhat complicated, and readers not interested in economic theory in detail may prefer to skip to section 7.323.

7.3221. The All or None Demand Curve

To begin, we need to refer to a second kind of relation between cents per 10 pounds and tonnage inspected. Following Patinkin,[1] this second relation is called an all or none demand.

Consider the quantity that shipper i actually had inspected in 1966 (q_i). Consider also the maximum fee that shipper i would have been willing to pay to

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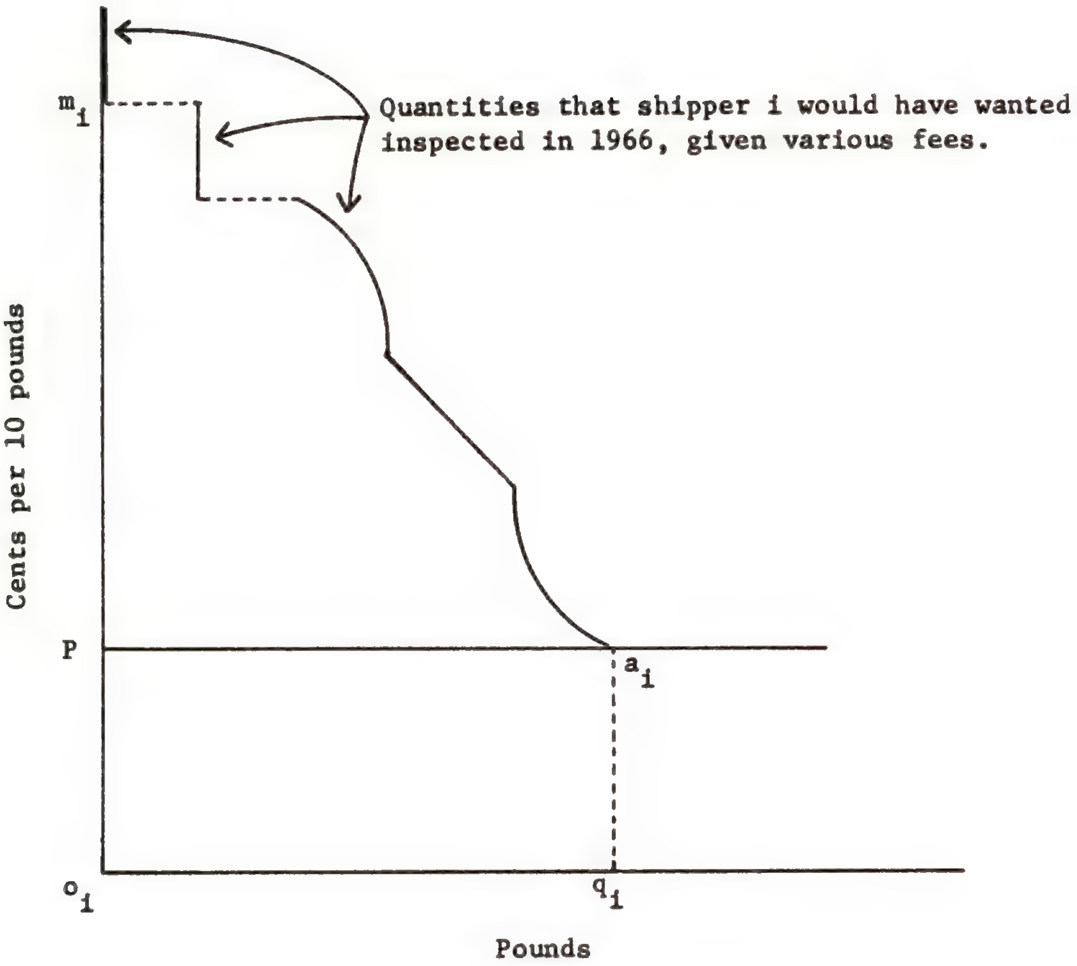
[1] Patinkin, *loc. cit.*

FIGURE 7.3

Hypothetical Ordinary Demand of Shipper i in 1966



have this quantity inspected (assuming that other shippers paid the same fee as he)--say, the fee at point f in Figure 7.4. The quantity-price combination just identified constitutes one point on shipper i's all or none demand curve--the point h_i in Figure 7.4. Other points on this curve can be identified by referring to the maximum fee that shipper i would have been willing to pay to have various other quantities inspected. However, we need to consider only quantities that are less than or equal to q_i. For this range, shipper i's all or none demand might be the kinked linear relation m_i b_i h_i in Figure 7.4.

Shipper i's all or none demand curve will, as Figure 7.4 indicates, lie on or above his ordinary demand curve. This relation follows from the fact that the maximum fee that a shipper would have been willing to pay to have a given quantity inspected is at least as large as the fee that he actually would have paid if he had chosen to have that quantity inspected.

The reason we have introduced the concept of an all or none demand is to use it to define a third kind of relation between cents per lug and number of lugs. Still following Patinkin,[1] we will call this third kind of relation a compensated demand.

7.3222. The Compensated Demand Curve

Shipper i's compensated demand is related to his all or none demand in the way that a curve showing marginal revenue (or cost) at various quantities is related to a curve showing average revenue (or cost) at various quantities. Let us be more precise.

If we knew shipper i's all or none demand, we would know the maximum fee that he would have been willing to pay for various quantities. For example, the point h_i in Figure 7.4 shows the maximum fee for quantity q_i. We could then readily calculate the maximum total amount of money that shipper i would have been willing to pay for various quantities, since the maximum total amount of money for any one quantity is the product of the maximum fee for that quantity times that quantity. For example, the rectangular area f h_i q_i o_i in Figure 7.4 shows the maximum total amount of money for quantity q_i.

Consider now the rate of change of this maximum total amount of money with respect to shipper i's quantity. In other words, consider the amount that the maximum total amount of money would increase with a one-lug increase in shipper

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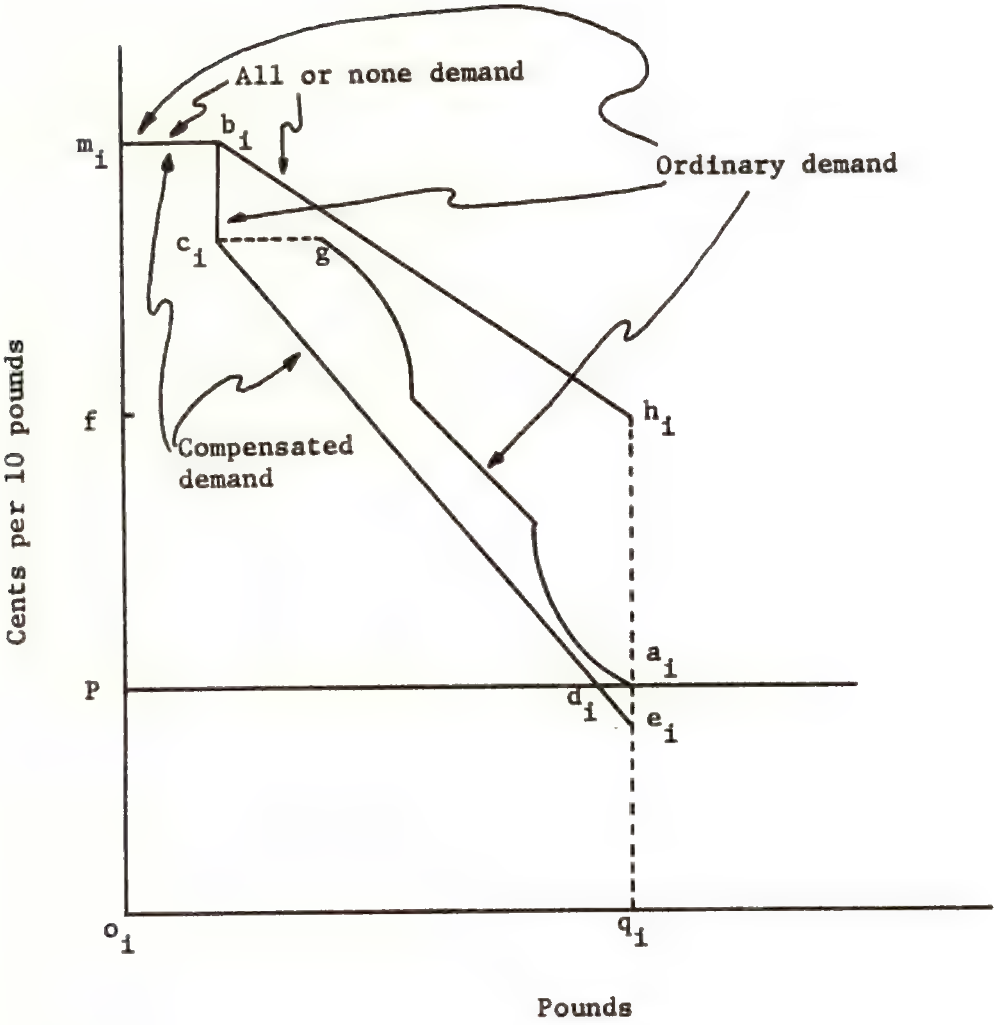
[1] *Loc. cit.*

FIGURE 7.4

Hypothetical Demand of Shipper i in 1966



i's quantity. This rate of change will, in general, be different if different quantities are to be increased by one lug. In any event, the schedule showing what value this rate of change had at various quantities for shipper i is called shipper i's compensated demand.

Expressed differently, shipper i's compensated demand shows, for each quantity, the maximum fee that shipper i would have been willing to pay to have one more lug inspected if he already had arranged for SPI to inspect the quantity at issue and to charge him the full amount of money that he would have been willing to pay to have that quantity inspected (provided that other shippers were charged the same amount per lug that shipper i was charged). Put still differently, shipper i's compensated demand is so constructed that the triangular area $m_i\ b_i\ c_i\ e_i\ q_i\ o_i$ in Figure 7.4 equals the rectangular area $f\ \ h_i\ q_i\ o_i$; this follows from the fact that the area beneath a curve showing marginal value from a quantity of zero to any positive quantity equals that positive quantity times the price assigned to that quantity by the curve showing average value. Both of these areas, then, represent the maximum amount of money that shipper i would have been willing to pay SPI for the quantity q_i (provided other shippers paid the same higher fee).

Shipper i's ordinary demand curve will, we expect, lie on or above his compensated demand curve. That is, any price shown for a particular quantity by his ordinary demand curve will be at least as large as the price shown for that quantity by his compensated demand curve. The compensated demand implied by the all or none demand also is shown in Figure 7.4.

The reason why we expect shipper i's ordinary demand curve to lie on or above his compensated demand curve is that both curves indicate how much shipper i would have been willing to pay, at various quantities, to have one more lug inspected, but the compensated demand curve indicates this for a case where shipper i would have agreed to pay a larger amount of money to have the other lugs inspected. We will elaborate because the point is important below, but to follow the argument will try your patience, and you may prefer to skip to the next heading.

A proof has three steps. The first step is to realize the following: the price (or, more generally, any price) shown for a particular quantity by shipper i's ordinary demand curve is at least as large as the maximum fee that shipper i would have been willing to pay to have one more lug inspected if he already had arranged for SPI to inspect that quantity and to charge him the price in question. This statement is an inference. The explanation is that there is only one plausible reason why shipper i, when confronted with a particular price, would have chosen a particular quantity and not one lug more than that quantity, and that reason is that the price in question was at least as large as the maximum fee that shipper i would have been willing to pay to have one more lug inspected under those circumstances.

The second step in the proof concerns shipper i's compensated demand. The price that shipper i's compensated demand assigns to any quantity is, as we said earlier, the maximum fee that he would have been willing to pay to have one more lug inspected if he already had arranged for SPI to inspect the quantity at issue and to charge him the price shown for that quantity by his all or none demand curve. The latter price is at least as large as any price shown for the same quantity by his ordinary demand curve, since the all or none curve lies on or above the ordinary curve. Accordingly, shipper i's net worth would be at least as large if he had agreed to pay any price shown for a particular quantity by his ordinary demand curve as if he had agreed to pay--as his compensated demand presupposes--the price shown by his all or none demand curve.

Now earlier we decided to assume that a reduction in a shipper's net worth would not increase the maximum fee that the shipper was willing to pay to have any quantity inspected. Accordingly, the maximum fee that shipper i would have been willing to pay to have one more lug inspected if he already had arranged to have a quantity inspected at a price shown for that quantity by his ordinary demand curve is at least as large as the price shown for that quantity by his compensated demand curve. This statement was the objective of the second step.

So far, we have seen, first, that any price shown for a particular quantity by shipper i's ordinary demand curve is at least as large as the maximum fee that he would have been willing to pay to have one more lug inspected if he already had arranged to have that quantity inspected at that price; and, second, that the maximum fee that shipper i would have been willing to pay to have one more lug inspected if he already had arranged to have a particular quantity inspected at any price shown for that quantity by his ordinary demand curve is at least as large as the price shown for that quantity by his compensated demand curve.

It follows--and this is the final step in the argument--that any price shown for a particular quantity by shipper i's ordinary demand curve is at least as large as the price shown for that quantity by his compensated demand curve. In other words, shipper i's ordinary demand curve will lie on or above his compensated demand curve--as we wanted to demonstrate.

7.3223. Individual Benefits as Areas Under Compensated Demand Curves

If we knew shipper i's compensated demand, we could determine his gross and net benefits. Consider first his gross benefit.

Shipper i's gross benefit was the largest amount of money that he would have been willing to pay SPI for the inspection services that he actually received in 1966 (assuming that SPI's fee to other shippers increased to the same level that he paid). This amount of money, as we have seen, is the area under shipper i's compensated demand curve from a quantity of zero to a quantity of q_i. In Figure 7.4, this area is the triangular area $m_i\ b_i\ c_i\ e_i\ q_i\ o_i$.

Shipper i's net benefit was the difference between his gross benefit and his actual payments to SPI. In Figure 7.4, his gross benefit is the area $m_i\ b_i\ c_i\ e_i\ q_i\ o_i$, and his actual payments were the area $P\ a_i\ q_i\ o_i$. Shipper i's net benefit, accordingly, was the difference between the triangular area $m_i\ b_i\ c_i\ d_i\ P$ and the triangular area $d_i\ a_i\ e_i$. In other words, his net benefit was the area between his compensated demand curve and a line at the level of the actual fee, from a quantity of zero to a quantity of q_i.

In the general case, then, individual benefits correspond to areas under the individuals' compensated demand curves.

7.3224. Relation to Areas Under Ordinary Demand Curves

This brings us to an important point: if we knew shipper i's ordinary demand, but not his compensated demand, and if it was not a yes or no ordinary demand, we could not ascertain either his gross benefit or his net benefit, but we could find an upper bound on both his gross benefit and his net benefit.

Consider first shipper i's gross benefit. The area under shipper i's ordinary demand curve between a quantity of zero and a quantity of q_i, that is, the area $m_i\ b_i\ c_i\ ga_i\ q_i\ o_i$ in Figure 7.4, is greater than or equal to the area $m_i\ b_i\ c_i\ e_i\ q_i\ o_i$, that is, greater than or equal to shipper i's gross benefit.

Consider now his net benefit. The area between shipper i's ordinary demand curve and a line at the level of the actual price, that is, the area $m_i\ b_i\ c_i\ ga_i$ P in Figure 7.4, is greater than or equal to the difference between the area $m_i\ b_i\ c_i\ d_i$ P and the area $d_i\ a_i\ e_i$, that is, is greater than or equal to shipper i's net benefit.

Both conclusions follow from the fact that shipper i's ordinary demand lies on or above his compensated demand.

How much would these upper bounds overstate shipper i's actual gross and net benefits? The answer depends on how much his ordinary demand lies above his compensated demand, that is, on the area between the two curves from a quantity of zero to a quantity of q_i. This area, in turn, depends on three things. First, it depends on how much more money shipper i would have paid for each quantity below q_i if he had paid the price shown for that quantity by his all or none demand curve instead of a price shown by his ordinary demand curve, that is, if he had paid an extra amount equal to the net benefit that he would have had if he had ended at that point on his ordinary demand curve. Second, it depends on the proportion by which his net worth would have decreased at each quantity as a result of paying the higher price. Third, it depends on how much of the maximum fee that he would have paid to have one more lug inspected would have decreased at each quantity as a result of the proportionate reduction in his net worth.

If any of these three changes is negligibly small at a quantity, then shipper i's ordinary demand will lie negligibly above his compensated demand at that quantity. The upper bounds then would be negligibly larger than his actual gross and net benefits.

7.323. Shippers' Collective Benefits with Sloping Ordinary Demands

Now consider shippers' collective benefits in the general case, that is, in the case wherein some shippers do not have yes or no ordinary demands. In particular, we need to relate shippers' collective benefits to areas under their collective demand curves.

7.3231. Collective Benefits as Areas Under the Collective Compensated Demand Curve

The collective ordinary demand of all shippers for SPI's services is, as we have seen, a horizontal sum of the ordinary demands of the individual shippers.

Similarly, the collective compensated demand is a horizontal sum of the individual compensated demands. Accordingly, the areas that measure individual shippers' gross and net benefits reappear as areas under the collective compensated demand.

To illustrate, Figure 7.5 shows what the collective compensated demand would look like if there were three shippers and each had a compensated demand with the shape shown in Figure 7.4, but with different maximum fees, that is, different values of m_i.

Consider the shipper whose maximum fee was highest--we call it m_1 in Figure 7.5. His gross benefit, which in Figure 7.4 was the area $m_i\ b_i\ c_i\ e_i\ q_i\ o_i$, reappears in Figure 7.5 as the area $m_1\ b_1\ c_1\ e_1\ q_1\ o_1$. His net benefit, which in Figure 7.4 was the difference between the areas $m_i\ b_i\ c_i\ d_i$ P and $d_i\ a_i\ e_i$, reappears in Figure 7.5 as the difference between the areas $m_1\ b_1\ c_1\ d_1$ P and $d_1\ a_1\ e_1$.

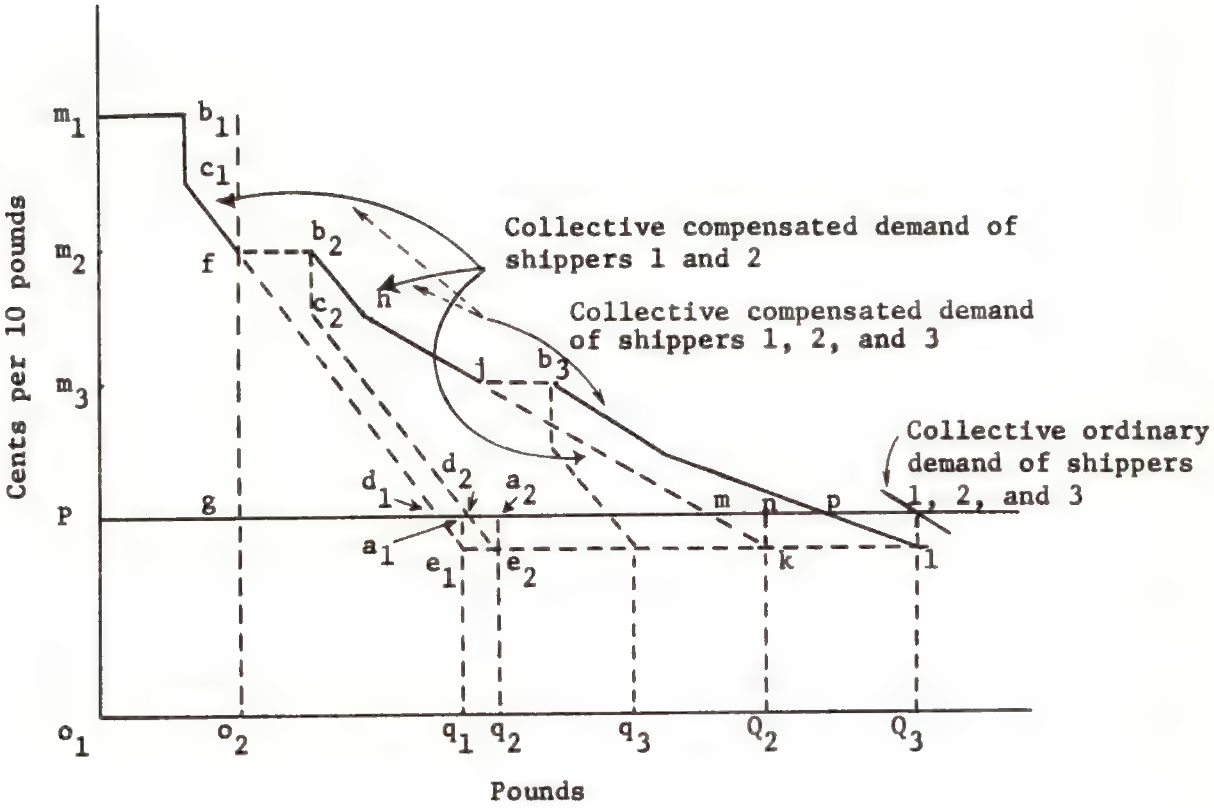
Consider now the shipper with the second highest maximum fee, which is called m_2 in Figure 7.5. His gross benefit appears in Figure 7.5 as the area $fb_2\ c_2\ e_2\ q_2\ o_2$. His net benefit appears as the difference between the area $fb_2\ c_2\ d_2$ g and the area $d_2\ a_2\ e_2$.

Consider now the sum of the gross benefits of these two shippers. This sum is the sum of the area $m_1\ b_1\ c_1\ e_1\ q_1\ o_1$ and the area $fb_2\ c_2\ e_2\ q_2\ o_2$. Since both these areas contain the area $fe_1\ q_1\ o_2$, their sum is equal to the sum of the area $m_1\ b_1\ c_1\ fb_2\ c_2\ e_2\ q_2\ o_1$ and the area $fe_1\ q_1\ o_2$. This area, $fe_1\ q_1\ o_2$, however, is equal to the area $b_2\ hkQ_2\ q_2\ e_2\ c_2$. This follows from the fact that the segmented line b_2 hk is a horizontal sum of the compensated demands of these two shippers. Hence, the sum of the two shippers' individual gross benefits is the area $m_1\ b_1\ c_1\ fb_2\ hkQ_2\ o_1$, that is, is the area under their collective compensated demand from a quantity of zero to a quantity of Q_2 (Q_2 being the combined quantity that these two shippers had inspected in 1966).

Similarly, the sum, over any n shippers, of their individual gross benefits turns out to be the area under their collective compensated demand from a quantity of zero to a quantity of Q_n (where $Q_n = \sum_{i=1}^{n} q_i$). Thus, for the three shippers represented in Figure 7.5, this sum is the area $m_1\ b_1\ c_1\ fb_2\ hjb_3\ lQ_3\ o_1$.

FIGURE 7.5

Hypothetical Compensated Demand of Three Shippers in 1966



The situation with net benefits is analogous. Consider the sum of the net benefits of shippers 1 and 2. This sum equals the area m_1 b_1 c_1 d_1 P minus the area d_1 a_1 e_1 plus the area fb_2 c_2 d_2 g minus the area d_2 a_2 e_2. Because both the first and third of these areas contain the area fd_1g, the sum of the two areas is equal to the sum of the area fd_1g and the area m_1 b_1 c_1 fb_2 c_2 d_2 P. The area fd_1g, however, is equal to the area b_2 hmd_2 c_2, since the line b_2hk is a horizontal sum of the lines b_1 c_1 e_1 and b_2 c_2 e_2. For the same reason, the sum of the area d_1 a_1 e_1 and the area d_2 a_2 e_2 is equal to the area mnk. Hence, the sum of the individual net benefits of shippers 1 and 2 equals the area m_1 b_1 c_1 fb_2 h m P minus the area mkn, that is, equals the sum of the positive and negative areas between their collective compensated demand and a line at the level of the actual price from a quantity of zero to a quantity of Q_2.

Similarly, the sum, over any n shippers, of their individual net benefits is the sum of the positive and negative areas between their collective compensated demand and a line at the level of the actual price from a quantity of zero to a quantity of Q_n. Thus, for the three shippers represented in Figure 7.5, this sum is the sum of the positive area m_1 b_1 c_1 fb_2 hjb_3 p P and the negative area pql.

7.3232. Relation to Areas Under the Collective Ordinary Demand

How do these areas relate to the corresponding areas under the collective ordinary demand? We have seen that each shipper's ordinary demand will lie on or above his compensated demand. As a result, the collective ordinary demand will lie on or above the collective compensated demand. This brings us to an important conclusion.

The conclusion is that the area under shippers' collective ordinary demand from a quantity of zero to a quantity of Q_n is at least as large as the area under their collective compensated demand from a quantity of zero to a quantity of Q_n. That is, the area under the collective ordinary demand is an upper bound for the shippers' collective gross benefit.

Similarly, the area between the shippers' collective ordinary demand and a line at the level of the actual price from a quantity of zero to a quantity of Q_n is at least as large as the sum of the positive and negative areas between their collective compensated demand and a line at the level of the actual price from a quantity of zero to a quantity of Q_n. That is, *the area between their collective ordinary demand and a line at the level of the actual price is an upper bound on the shippers' collective net benefit*.

7.3233. The Degree of Overstatement

In this subsection, we will see that areas under shippers' collective *ordinary* demand probably overstate their actual collective benefits to only a slight degree.

How much does the upper bound obtained by reference to shippers' collective ordinary demand overstate their collective gross and net benefits? The answer depends on how much of their collective ordinary demand lies above their collective compensated demand, that is, on the area that lies between the two curves from a quantity of zero to a quantity of Q_n. In turn, this area depends on the difference between the ordinary and the compensated demands of the individual shippers.

For any one shipper, the difference between these two curves depends, as we have seen, partly on how much his net worth would have decreased at each quantity below q_i if he had paid the price shown for that quantity by his all or none demand curve instead of the price shown by his ordinary demand curve, that is, if he had paid an extra amount equal to the net benefit that he would have had if SPI's price had led him to choose the quantity at issue. If the reduction in shippers' net worth would have been negligibly small, then the upper bounds will be negligibly larger than the actual values of gross and net benefits. Accordingly, we can judge whether our upper bounds substantially overstate actual benefits by referring to the amount that shippers' net worth would have decreased at each quantity if they had had to pay an extra amount equal to their net benefits, and by comparing this amount to shippers' sales revenues.

We can obtain an upper bound on the decrease in net worth at each quantity. The net benefit associated with shippers' actual quantity (Q_n), that is, associated with a price higher than SPI's actual price (P), is not less than the net benefit associated with any smaller quantity, that is, associated with a price higher than SPI's actual price. The reduction in net worth at *each* quantity, consequently, is not more than the net benefit associated with the actual quantity. The latter net benefit, however, is not more than the upper bound on it that we have derived. Hence, we can use our upper bound on shippers' actual net benefit as an upper bound on the decrease in net worth at each quantity. The figure, as we will see (section 7.5), is $660,644.

In contrast, California growers' total revenue for table grapes in 1966 was $18,256,000. This makes our upper bound on the reduction in net worth at each quantity only 3.6 percent of the shippers' total revenue. From this, we conclude that estimating gross benefits by referring to the area beneath shippers' collective ordinary demand curve instead of to the area beneath their collective compensated demand curve produces negligible overstatement.

7.4. Shippers' Collective Ordinary Demand in 1966

In this section, we will present our estimate of the collective ordinary demand that actually prevailed in 1966 for SPI's grape inspection service. We will describe, first, our attempt to estimate this demand by a standard statistical method and, second, our attempt to estimate it from data obtained by questionnaire. In both cases, we will be dealing with the combined demand for table grape and juice grape inspections; separate data are not available. According to SPI, "most" of the combined demand pertains to table grapes.

7.41. The Statistical Approach

When outputs not only are salable but, in fact, have been sold, one can try to estimate the demand function from historical data.

The conventional procedure involves two steps. The first is to postulate that quantity demanded was equal to quantity bought and was a fixed linear (or linearizable) function both of the price charged and of a number of other variables that seem to be relevant. The second step is to estimate the parameters of the postulated function, usually by the method known as "ordinary least squares." The procedure involves a number of assumptions, and the estimate of demand that emerges is subject to considerable error even if perfect data are available. In addition, available data usually are quite imperfect.

To estimate the collective ordinary demand of grape shippers for SPI's services, we used annual data for four variables: (1) tons of table and juice grapes inspected by SPI, (2) SPI's published fee for inspecting a 10-pound lug of grapes, (3) growers' revenue per ton of table grapes, and (4) the proportion of U.S. population outside of California (and therefore served by distant shipments). Data pertaining to SPI were available only for the nine years, 1958 through 1966. The figures are shown in Table 7.1.

SPI's published fee for inspecting a 10-pound lug is the variable that we used to represent SPI's price in the present context. We chose this variable for want of a better alternative. In fact, SPI had a schedule of fees. Thus, in 1966, SPI charged, as mentioned above, 0.8 cent per lug with a capacity of 10 pounds or less, 1.3 cents per lug for lugs with a capacity between 10 and 24 pounds, and 1.5 cents per lug for lugs with a capacity of 24 pounds or more. If a shipper used lugs containing 26 pounds--a common situation--his cost per 10 pounds would have been 0.58 cent, that is, 72 percent of the fee for 10-pound lugs. SPI's actual weighted average fee for grapes in 1966 was 0.55 cent per 10 pounds ($348,831 in revenues divided by 633,297,000 pounds inspected, times 10 to convert from a per pound basis). Nevertheless, it is changes in fees that matter for present purposes, and the change in the fee for 10-pound lugs presumably served to reflect changes in the whole fee schedule.[1/]

A number of functions that might reasonably be postulated were considered. The parameters of each function were estimated by ordinary least squares. The function that produced the best fit to the data had, as the dependent variable, the natural logarithm of the ratio between tons of table and juice grapes inspected by SPI and tons of table grapes produced in California (designate this variable $\ln Y$). There were three independent variables. The first (X_1) was the year, coded so that 1958 = 1 and 1966 = 9. The second ($\ln X_2$) was the natural logarithm of growers' revenue per ton (not per 10 pounds, as is shown in Table 7.1 to facilitate comparisons). The third ($\ln X_3$) was the natural logarithm of the proportion of U.S. population outside of California.

The estimates of the parameters that we obtained, together with their t-ratios, are as follows:

$$\ln Y = 8.41 + .36\, X_1 + .59 \ln X_2 + 140 \ln X_3$$
$$(t = 5.15)\quad (t = 4.48)\quad (t = 4.29)$$

[1/] There were two further complications. First, before 1964, SPI's fees were expressed, not per lug, but per carlot. Second, for a small part of the tonnage, a different fee schedule has been used. Starting in 1963, if a shipper agreed to have his entire pack inspected and if he promised to incur charges averaging $56 per day per inspector, he was charged a combination of a rate per hour and a rate per container. In 1966, the rate per hour was $3.60 and the rate per container was .26 cent for lugs with a capacity of 10 pounds or less, .5 cent for lugs with a capacity between 10 and 24 pounds, and .65 cent for lugs with a capacity of 24 pounds or more.

TABLE 7.1

Data for Selected Variables

Calendar year	Table and juice grapes inspected by SPI[a]	SPI's fee for 10-pound lugs	Growers' revenue per 10 pounds of table grapes	California production of table grapes	One minus ratio of California to U.S. population	Ratio of grapes inspected to California production
	1,000 tons	cents		1,000 tons		
1958	188	0.50	31.45	530	.916	.35
1959	217	0.50	27.04	532	.915	.41
1960	232	0.50	24.45	560	.913	.41
1961	186	0.50	25.00	445	.911	.42
1962	276	0.50	25.14	578	.909	.48
1963	257	0.50	20.65	622	.907	.41
1964	268	0.50	26.94	517	.905	.52
1965	313	0.76[b]	16.30	650	.904	.48
1966	317	0.80	16.30	560	.903	.57

[a] Data were available only for carlots. However, we were able to estimate tons from carlots. For 1958-1965, we used 13.5 tons per carlot; for 1966, 15.9 tons per carlot.

[b] SPI's fee was raised June 1, 1965. The figure shown is a weighted average of 0.50 and 0.80, the weights being shipments. By June 1, 13.32 percent of California's 1965 shipments of (all) grapes by truck had occurred (see Federal-State Market News Service, *Truck Passings of California Fresh Fruits and Vegetables Through California Border Stations*, Sacramento, annual issue, 1966.

Source: Columns 2,3: Records of the Bureau of Shipping Point Inspection, California State Department of Agriculture.

Columns 4,5: California Department of Agriculture, California Crop and Livestock Reporting Service, *California Fruit and Nut Crops, 1909-1955, Acreage, Production, Utilization, Value*, Sacramento.

Column 6: U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States*, Washington, D.C., 1967.

Column 7: See Columns 2 and 5.

The unadjusted coefficient of determination (commonly denoted R^2) was .96 and the coefficient adjusted for degrees of freedom was .94. The standard error of estimate was .035. These figures indicate that the function provides a very close fit to the data. Furthermore, for each of three independent variables, the hypothesis that the true value of the coefficient is zero can be rejected at the 1 percent level of significance.

What do the three coefficients mean? The coefficient of X_1 means that after allowing for the influence of X_2 and X_3, the ratio of tons inspected to tons produced in California trended upward at the rate of 43 percent per year during the nine-year period. The coefficient of $\ln X_2$ means that after allowing for the influence of X_1 and X_3, the ratio of tons inspected to tons produced in California rose, on the average, by .59 percent for each 1 percent increase in the price received by California grape producers. The coefficient of $\ln X_3$ means that, after allowing for the influence of X_1 and X_2, the ratio of tons inspected to tons produced fell an average of 14 percent for each .1 percent decrease in the proportion of U.S. population outside of California.

For two other variables, coefficients were not significantly different from zero. These variables, accordingly, were deleted from the equation.

One of the deleted variables was the amount of California production of table grapes. Apparently the amount produced did not affect the proportion inspected.

The other deleted variable was SPI's fee. It did not prove significant in natural form, in logarithmic form, as a proportion of growers' revenue per ton, or in any other way. Apparently the tonnage that SPI inspected was not significantly affected by the level of SPI's 10-pound fee within the range that that fee varied between 1958 and 1966. Accordingly, our attempt to estimate shippers' collective ordinary demand by statistical means was not successful.

7.42. The Questionnaire Approach

In this subsection, we will derive an estimate of grape shippers' collective ordinary demand in 1966. The estimate will be made from two kinds of information.

One kind is the actual quantity-price result for 1966. As noted in subsection 7.41, SPI inspected 633,297,000 pounds of grapes ("mostly" table grapes) in 1966 and received a weighted average fee of 0.55 cent per 10 pounds.

The other kind of information to be used came from our questionnaire. In it, we said: "There is some fee level at which it would be uneconomical for you to subscribe to the inspection service. This is, more likely than not, higher than the present fees. Would you please attempt to estimate the charge at which you would fully discontinue the Federal-State inspection? For example: $.01 per 10 pounds or $.015 per 10 pounds." Twenty-five shippers answered this question. Their answers are shown in Table 7.2.

Judging by the answers, SPI could not have charged more than 5.4 cents per 10 pounds without reducing the tonnage that grape shippers would have had inspected to zero. Accordingly, we will take 5.4 cents per 10 pounds to be the vertical intercept of shippers' collective ordinary demand curve.

We now have two points on this demand curve, namely, the vertical intercept, that is, (0 pounds, 5.4 cents), and the actual quantity-price point, that is, (633,297,000 pounds, 0.55 cent).

Intervening points we will estimate by assuming that each of the 25 answers shown in Table 7.2 applied to 1/25 of SPI's grape tonnage. For example, we will assume that raising the weighted average fee from the actual figure (0.55 cent) to the lowest figure shown in Table 7.2, namely, 0.8 cent, would have reduced SPI's tonnage inspected by 2/25, since two of the 25 respondents gave 0.8 cent as the fee at which they would have discontinued using SPI.[1] Similarly, we will assume that raising the weighted average fee from 0.8 cent to the second lowest figure shown in Table 7.2, namely, 1.0 cent, would further have reduced SPI's tonnage inspected by 3/25 of the actual 1966 tonnage, since three of the 25 respondents gave 1.0 cent as their maximum fee. In each case, we will also assume that the reduction in tonnage between any two fees would have occurred linearly.

Following this procedure, we obtain the demand curve shown in Figure 7.6. It is our estimate of the collective ordinary demand for SPI's inspection service by shippers of table and juice grapes in 1966.

7.5. Our Numerical Estimate of the Benefit-Cost Ratio

In this section, we will present our numerical estimate of the 1966 benefit-cost ratio for SPI's grape inspection activities, together with our

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[1] We could not take account of the respondents' relative sizes. Most of them declined to supply tonnage information.

TABLE 7.2

Maximum Fees Stated by Responding Shippers

Stated fee (cents per 10 pounds)	Frequency
5.4	1
2.5	1
2.4	2
2.0	7
1.6	2
1.5	5
1.3	2
1.0	3
0.8	2
	25

numerical estimate of grape shippers' collective gross and net benefits in 1966. Because we could not separate the demand for table grape and juice grape inspections, all our estimates will pertain to the two combined.

The numerator of the 1966 benefit-cost ratio is the dollar value of the benefits of SPI's grape inspection activities in 1966. Since we believe that benefits accrued primarily to the shippers whose grapes were inspected, our estimate of the dollar value of program benefits is the same as our estimate of grape shippers' collective gross benefit. The latter, as we know from the discussion in section 7.3233, can be approximated by the area under the shippers' collective ordinary demand for SPI's services from the quantity zero to the quantity actually inspected.

Our estimate of the collective ordinary demand for SPI's services by table and juice grape shippers in 1966 was presented in Figure 7.6. The relevant area under this curve is equal to $1,009,475.[1] Accordingly, our estimate of the dollar value of grape inspection benefits in 1966 is, in round numbers, $1.0 million.

Shippers had to pay to obtain their benefits. Shippers' collective net benefit, as a result, was less than their collective gross benefit by the amount of their payments. Grape shippers' payments in 1966 (Table 3.1) amounted to $348,831. Accordingly, we estimate the shippers' collective net benefit in 1966 to have been $660,664 or, in round numbers, $660,000. This sum is the area between the collective ordinary demand shown in Figure 7.6 and a horizontal line at 0.55 cents per 10 pounds (the weighted average fee that shippers paid in 1966). Neither net benefit nor shippers' payments, however, enters the benefit-cost ratio.

The denominator of the ratio consists of the dollar value of the program's social costs. Since we believe that virtually all of the social sacrifices entailed by SPI's grape inspection work consist of SPI's use of its purchased inputs

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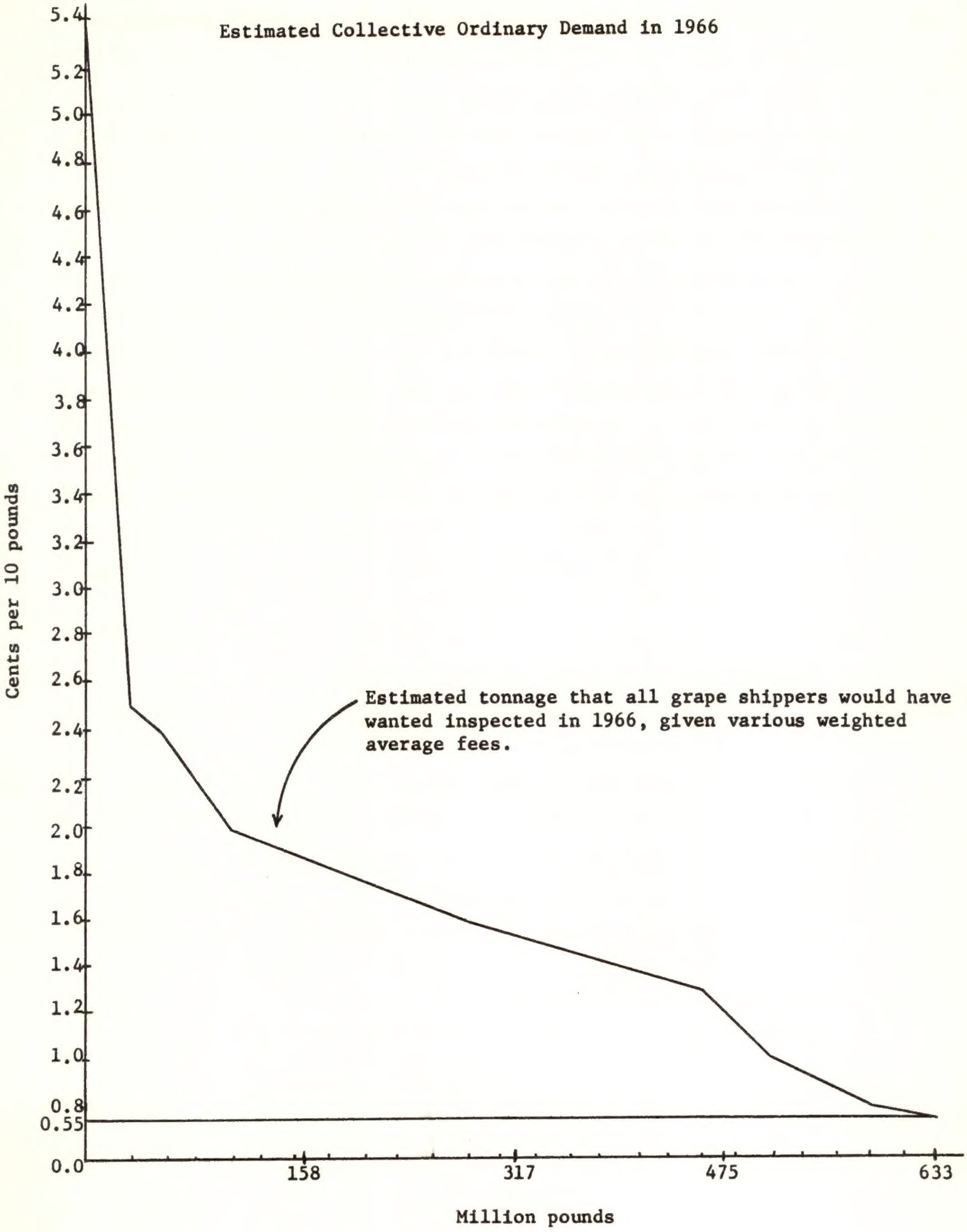
[1] The calculation runs as follows:

$$
\begin{aligned}
(1/10)\ (633{,}297{,}000)\ \ [&(1/25)\ (\$0.054 + \$0.025)\ /2 \\
+ &(1/25)\ (\$0.025 + \$0.024)\ /2 \\
+ &(2/25)\ (\$0.024 + \$0.020)\ /2 \\
+ &(7/25)\ (\$0.020 + \$0.016)\ /2 \\
+ &(2/25)\ (\$0.016 + \$0.015)\ /2 \\
+ &(7/25)\ (\$0.015 + \$0.013)\ /2 \\
+ &(2/25)\ (\$0.013 + \$0.010)\ /2 \\
+ &(3/25)\ (\$0.010 + \$0.008)\ /2 \\
+ &(2/25)\ (\$0.008 + \$0.0055)/2] = \$1{,}009{,}475.
\end{aligned}
$$

FIGURE 7.6



Estimated Collective Ordinary Demand in 1966

Estimated tonnage that all grape shippers would have wanted inspected in 1966, given various weighted average fees.

and since we have no reason to revise SPI's bookkeeping, our estimate of the dollar value program's social costs is equal to SPI's explicit or book cost for grape inspections. For 1966, SPI's total explicit cost for table and juice grape inspection was $365,569 (see Table 3.1). This is our denominator.

Finally, we come to the benefit-cost ratio itself. If the dollar value of program benefits in 1966 was $1,009,475 and the dollar value of program costs in 1966 was $365,569, the ratio was 2.761. Accordingly, we estimate the benefit-cost ratio for SPI's grape inspection work in 1966 at 2.8.

We do not place much faith in this number nor suggest that it be used in reaching any decisions. The figure 2.8 is merely the ratio between (a) our rather subjective estimate of the monetary value that the direct beneficiaries would place on their gross benefits and (b) the bookkeepers' estimate of the expenditures chargeable to the program. We have calculated the ratio only to illustrate both how much and how little can be said about the benefit-cost ratio in the most favorable case, that is, when the direct beneficiaries purchase the program's outputs. We place more faith in the ability of economic analysis to generate the other kinds of information discussed above--(1) the rationale for governmental operation, (2) the appropriateness of user charges, (3) the effectiveness of program operation, (4) the possibility of reducing costs, and (5) the expenditures implied by program expansion.